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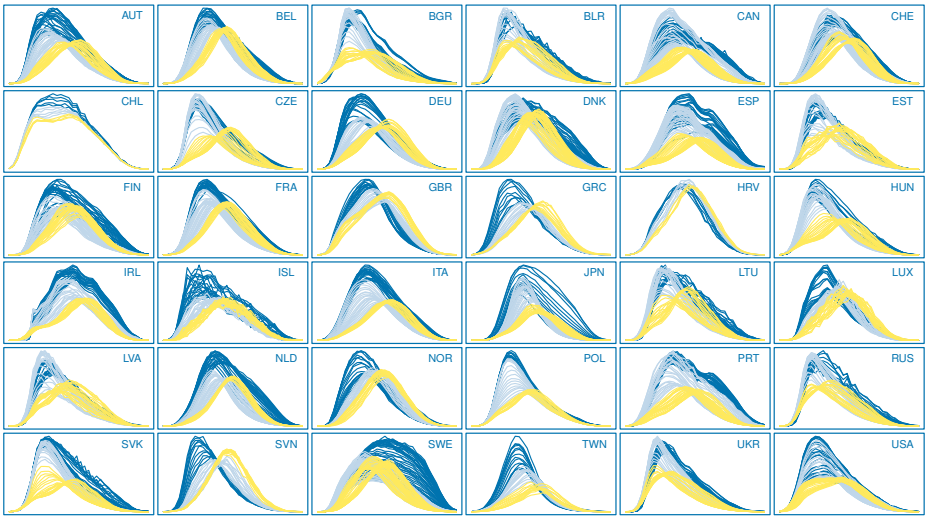

"Fertility across time and space"

Guest Editors: Tomáš Sobotka, Aiva Jasilioniene, Kryštof Zeman and Diego Ramiro Fariñas

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Guest editors:
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Introduction: the relevance of studying fertility across time and space

Tomáš Sobotka[1,*]

1 The contemporary global variation in fertility

Research on aggregate-level trends, patterns and determinants of fertility has always been at the top of demographers' agendas. Ultimately, questions about fertility and reproduction touch upon the fundamental issue of the replacement and survival of our species (Coleman 1998). Current "ultra-low" fertility rates in many countries in Europe and East Asia give rise to concerns about the potential demographic implosion and its consequences (e.g., Funabashi 2018). At the same time, some countries in Sub-Saharan Africa continue to have very high fertility rates (see Shapiro and Hinde in this volume) that fuel long-term demographic momentum. As Potts et al. (2011) observed about the situation in Niger, this trend "casts a threatening shadow" over the future of these countries, and over the sustainability of their populations. Although global fertility has been converging to relatively low levels across most countries and regions (Strulik and Vollmer 2013), the gap between the highest-fertility country, Niger, with an estimated total fertility rate (TFR) of 6.95 in 2015–2020 (UN 2019), and South Korea, with a TFR of 0.92 in 2019, remains huge.

In between these two extremes and the two contrasting concerns about very low and very high fertility, the study of macro-level fertility remains key for understanding past population trends and for projecting future population. Two factors, the pace of the fertility decline in Sub-Saharan Africa and the depth of the fertility decline in low-fertility countries, will determine future global population growth, and its eventual stabilisation or reversal (Lutz et al. 2018; Vollset et al. 2020). Many big questions regarding fertility trends and determinants have not yet been sufficiently answered or studied. As countries complete the (first) fertility transition, is fertility likely to fall to very low levels in most societies? If it does, is it likely to recover later, or to remain stuck at very low, "suboptimal" levels for many decades,

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thus locking countries in a *low fertility trap* (Lutz et al. 2006), and heralding a shift towards low family size ideals and preferences? Recent experiences of economic shocks and the uncertainty resulting from the COVID-19 pandemic make such a shift more likely, and add another layer of uncertainty about the future direction of fertility change.

In addition to being unable to answer these questions, our insufficient understanding of contemporary changes in fertility and reproduction is underscored by the ongoing lively discussions on the factors driving fertility change, variation and reversals in post-transitional societies. The pronounced fertility declines recorded since 2008 in many of the countries that already had low fertility took many demographers by surprise, and stimulated reflections about the changes in fertility preferences, the new meaning of parenthood and reproduction, and the changes in partnership formation patterns among young adults (see Sections 3 and 4 below).

This issue of the *Vienna Yearbook of Population Research* brings together many perspectives on the past, present and future of fertility. It features a selection of articles that were presented at the 2018 *Wittgenstein Centre Conference* and the *Third Human Fertility Database Symposium* on "Fertility across Time and Space", and invited contributions that discuss the key drivers of future fertility. This volume covers both countries with very high fertility (article by Shapiro and Hinde) and countries with "ultra-low fertility", especially in East Asia (contributions by Cheng and Fukuda). It features studies on historical fertility declines (Poulain et al. on marital fertility in Sardinia), as well as articles dealing with recent trends (e.g., the study by Cheng) and presenting fertility projections (article by Potančoková and Marois). While many of the articles are empirically oriented, some have a strong methodological (contribution by Mogi and del Mundo) or theoretical focus (articles by Cavalli and by Poulain et al.). Most of the contributions focus on fertility levels, but several shed light on changes in fertility timing (studies by Kazenin and Kozlov, and by Mogi and del Mundo). The articles also provide diverse geographical coverage, ranging from a global perspective (study by Cavalli), to a focus on broader regions or groups of countries (articles by Potančoková and Marois; Mogi and del Mundo; Shapiro and Hinde; and by Cheng), to one-country studies (article by Kazenin and Kozlov), to in-depth research focusing on historical fertility change in two villages in Sardinia (research by Poulain et al.).

To discuss and position each contribution within contemporary fertility research, I outline some of the key research themes and questions on aggregate-level fertility they address, and discuss the emerging features of post-transitional fertility (Section 2). Then, I review the arguments and conclusions in the *Demographic Debate* regarding the main factors that are likely to affect fertility in the future (Section 3). Finally, I speculate about the emerging features of a new fertility landscape characterised by new uncertainties, lower reproductive preferences and depressed fertility.

2 Key questions in contemporary macro-level fertility research

Fertility rates in many parts of the world are continuing to change rapidly, and often in initially unexpected directions (e.g., Hellstrand et al. 2020a and Rotkirch this volume). In addition, period fertility rates are frequently affected by changes in the timing of union formation and childbearing, contributing to their instability. The studies in this volume can help us analyse and understand the diversity of contemporary fertility change. To review these studies in more detail, I outline selected key questions in contemporary fertility research that they address.

2.1 What drives the fertility shift from high to relatively low fertility levels?

This is the core question pertaining to the fertility transition and its mechanisms, and, in a broader perspective, to the (first) demographic transition. To date, there is considerable disagreement about the extent to which the fertility transition is driven by structural and socio-economic forces, or by technological and ideational changes (Bryant 2007). Michel Poulain, Dany Chambre, Pino Ledda, and Anne Herm address the main premise of the demographic transition theory: i.e., that a decrease in infant and child mortality precedes the onset of fertility decline, and that mortality decline is an important driving force of fertility change. Poulain et al. provide an in-depth investigation of marital fertility transitions in two villages in Sardinia. Their study, covering a period from the late 19th century to the present time, concludes that the close association between the decreases in mortality and fertility indicates that the decline in stillbirths and infant mortality in the studied populations "might have been at least partly responsible for the corresponding decrease in fertility" (p. 231). At the level of individual families, the "number of surviving children, rather than a specific number of births, serves as an important predictor of the likelihood of having another child" (p. 232). However, the causal link between mortality and fertility appears to run in both directions: longer birth intervals and a lower number of children born – two manifestations of the progressing fertility transition – are also found to be associated with better chances of children surviving, and, thus, with lower early mortality. In addition, broader socio-economic and cultural developments – including improvements in health care, well-being, transport links and education – are shown to be associated with both declining mortality and family size limitation.

The contemporary debate on the fertility transition often focuses on higher-fertility countries, especially in Sub-Saharan Africa, and the drivers of fertility change in the region. Two important contributions, by Bongaarts and Casterline (2013) and by Bongaarts (2017), examine the unique features of the African fertility transition. They document that fertility decline in Sub-Saharan Africa, once initiated, has been slower than in other world regions (see also Shapiro

and Hinde 2017), and that the ideal family size remains higher there than it is elsewhere. In addition, women in many parts of the continent have poor access to modern contraception and high rates of unmet need for contraceptive use. While the correlations between the main indicators of socio-economic development (GDP per capita, education, life expectancy and urbanisation) and fertility in the region have the expected negative sign, Bongaarts (2017: 55) highlights what he calls *the Africa effect*: at "a given level of development, Africa's fertility is higher, contraceptive use is lower, and desired family size is higher" than in the less developed countries outside the continent. Many societies in Sub-Saharan Africa are characterised by a strong pro-natalist culture that sustains higher family size preferences.

David Shapiro and Andrew Hinde contribute to the debate on the factors driving the fertility transition in the region. They examine fertility change and broader socio-economic and demographic factors affecting fertility in seven countries of Sub-Saharan Africa that have the highest fertility rates globally, and are the "laggards" in the global fertility transition: Chad, the Democratic Republic of Congo (DRC), Equatorial Guinea, The Gambia, Mali, Niger and Somalia. While all of these countries have experienced the onset of fertility decline, their fertility levels have declined slowly. Indeed, by 2010–2015, five of these countries had not even met the criterion of a 10 per cent decline from the peak level that is often used as a benchmark for fertility transition. Shapiro and Hinde document that the analysed countries are experiencing a combination of social, economic and cultural factors that are sustaining their higher fertility levels and slowing their fertility declines. In comparison with other countries in the region, they display much lower levels of modern contraception use – especially among women in a union – earlier marriage, higher ideal family sizes (reaching a staggering 9.2 children per woman in Niger; see Table 2 in Shapiro and Hinde, this volume), fewer years of schooling and higher shares of the population with no education (except in the DRC); and, in most countries, lower GDP per capita and higher infant and child mortality. All of the analysed countries except the DRC have a high proportion of Muslims in the population, ranging from 65% in Chad to 100% in Somalia, and thus reflect the stronger preference for children among Muslim women. Taken together, these factors form a "multi-dimensional space" associated with "fertility promoting values" as well as "resistance to fertility decline". The current high fertility rates in these countries build up momentum for continued rapid population growth in the coming decades, posing challenges to improvements in well-being, and contributing substantially to future population growth in Sub-Saharan Africa.

Future fertility trends in the "laggard countries" and in the region as a whole will also be affected by violence and governance failures. Alicia Adsera's debate contribution brings up the "lack of leadership" as one of the key forces hampering broader socio-economic development, and thus slowing down the pace of fertility decline. It is no coincidence that a number of the countries analysed by Hinde and Shapiro are experiencing violent ethnic and religious conflicts (Chad, DRC, Mali, Niger, Somalia), and their governments do not have full control over the whole territory. Most of these countries have dysfunctional and weak governments that are

not able to deliver even basic infrastructure, education, health care and security to their populations. In the countries that are managing to expand education, especially for girls, Wolfgang Lutz (this volume) highlights the dual effect of education on lowering fertility: it "reduces the ideal family size, presumably through changes in values and in the associated quantity/quality considerations; and it empowers women to actually realize this smaller family size by averting unwanted births" (p. 64).

2.2 Which factors sustain the fertility transition, and which factors contribute to fertility stalls and reversals?

Once the fertility transition is under way, is it likely to proceed without interruptions until fertility reaches low levels? Or does fertility decline often follow a less straightforward trajectory marked by stalls and reversals? Which factors sustain the transition to low fertility? Studies published since the early 21st century have examined the rising number of countries in Africa, Asia and Latin America where the shift towards lower fertility has at least temporarily stalled, and have discussed the factors contributing to these stalled transitions. Looking at seven countries across these three continents, Bongaarts (2006) concluded that these stalls in the fertility transition were linked to stagnating contraceptive use, and to a stabilisation in the demand for contraception and in the number of wanted births, with no evidence of rising unwanted or unplanned births. A number of studies have focused on the evidence of stagnation in the fertility transition in Africa in the 1990s and early 2000s. Bongaarts (2003) and Shapiro and Gebreselassie (2008) highlighted the role of educational improvements in the course of the fertility transition, observing that less educated women tend to have both a higher (although declining) desired family size and higher levels of unwanted fertility. They suggested that low or stagnating levels of schooling can cause the fertility transition to stall. In line with these expectations, Goujon et al. (2015) and Kebede et al. (2019) linked the stalling of the fertility transition in some countries of Sub-Saharan Africa to the setbacks in education in the 1980s and 1990s, when the share of women without formal education stagnated or declined only slightly in Kenya, Nigeria, Côte d'Ivoire and some other countries. At the same time, fertility rates among women with no education remained high or even increased, fuelling the overall stagnation or slowdown of the decline in period fertility.

The current evidence suggests that the experience of fertility stalls or reversals is relatively common in the countries undergoing the fertility transition, with some societies experiencing a prolonged period of stalling fertility at higher levels lasting two or more decades. Al Zalak and Goujon's (2017) analysis of increasing fertility in Egypt between 2005 and 2015 also showed that changes in the timing of marriage and childbearing could explain some of the fertility stalls. During that period, more women married at an early age (before age 25), and the previous gradual shift towards later marriage and childbearing had come to an end.

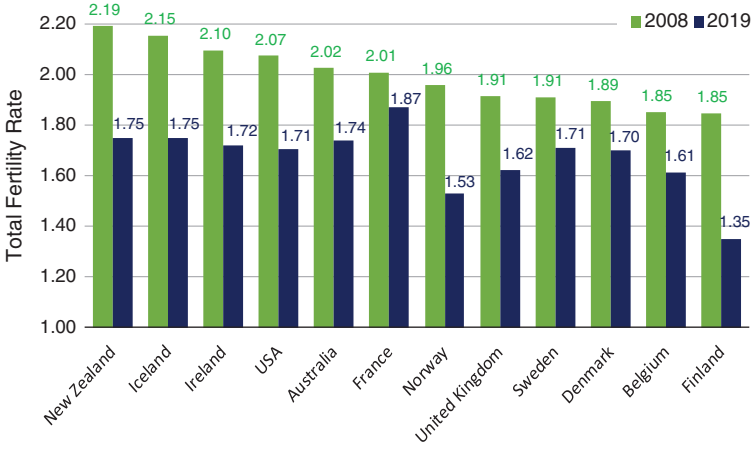
Although the fertility transition and the increase in educational attainment often lead to a shift towards later marriage and parenthood (Bongaarts et al. 2017), this trend is often uneven, and is far from universal among the transitional societies. Three of the Central Asian countries that were formerly part of the Soviet Union – Kazakhstan, Kyrgyzstan and Turkmenistan – experienced an upturn in their period fertility rates, and a shift towards earlier childbearing or a stabilisation in their patterns of early births in the 2000s and 2010s (Spoorenberg 2015). The study by Vladimir Kazenin and Konstantin Kozlov puts a spotlight on the absence of first birth postponement in Kyrgyzstan. The authors look at the socio-economic and cultural factors that have been sustaining the pattern of early union formation and childbearing in these countries. Their research underscores the role of the "expected" factors (especially lower education and rural residence), but also the importance of cultural and technological factors, such as access to information (limited access to the internet); acceptance of domestic violence as a measure of women's lack of power; and ethnicity, which is closely linked to religiosity and "traditionalism" in family relations. Women from the Uzbek ethnic minority, who have the lowest levels of educational attainment and internet access and the highest levels of acceptance of domestic violence among the three groups analysed, also display a pattern of early union formation and of a faster transition to the first birth after union formation. This analysis underscores that culture, religion and women's autonomy continue to affect fertility change and variation.

2.3 Emerging patterns of post-transitional fertility: stable preferences combined with low, delayed and unstable fertility rates

In the last three decades, many countries in Asia and Latin America – including Bangladesh, Brazil, China, Colombia, Iran, Malaysia, Turkey and Viet Nam – experienced a decline in their period TFR to sub-replacement levels, thus marking the completion of their fertility transition. A locus of low fertility has been increasingly moving towards middle-income countries. As ever more countries are set to join the "low-fertility club" in the near future, it is worth looking at the experiences of the countries that completed their fertility transition in the 1960s–1990s.

What are the key emerging features of post-transitional fertility? Arguably, the most important finding is the absence of a stabilisation of fertility around the replacement level. As Wolfgang Lutz (this volume) puts it, "we are groping in the dark and only feel confident in saying that the long-held view that all countries will ultimately converge to the so-called replacement level of 2.1 is untenable and without scientific basis" (p. 65). In most countries, period fertility continues to decline once this threshold has been hit. Over the last decade, all post-transitional countries with relatively higher fertility have experienced a decline in their period TFR, with most of them seeing their TFR drop from around 1.9-2.1 to around 1.7 (Figure 1). However, some of these countries saw a sharper fall in fertility: in 2019, the TFR plunged to 1.53 in Norway, and to a record low of 1.35 in Finland (Rotkirch, this volume).

Figure 1:
Total fertility rate (TFR) in 2008 and 2019 in highly developed countries with a higher TFR in 2008 (except Israel); data ranked from the highest value in 2008



Source: National statistical offices (October 2020).
Note: Recent data for Belgium and Australia refer to 2018; data for some countries are preliminary and may be revised.

These sharp declines are most unexpected in the Nordic countries, which are often seen as forerunners in implementing work-life balance policies (Lappegård this volume; Lutz this volume) that enabled them to achieve a "virtuous combination" of high levels of women's employment, high gender equality and relatively high fertility. While the recent fertility declines have been driven in part by a renewed trend towards delayed family formation, the spread, the magnitude and the duration of these fertility downturns indicate that they are likely to be more entrenched, and to lead to declines in cohort fertility as well (Hellstrand et al. 2020b for the Nordic countries).

With the possible exception of China (Basten and Gu 2013), the very low fertility observed in many post-transitional countries today does not reflect the reproductive intentions, desires and ideals of individual men and women. In Europe, the United States, Japan, Canada and other low-fertility countries, the indicators of family size preferences typically reach around or slightly above two births on average, and have remained relatively stable over time (Sobotka and Beaujouan 2014; Beaujouan and Berghammer 2019; Edmonston et al. 2010; Fukuda and Saotome 2018; see also Esteve et al. this volume). Among younger women across educational groups, including women with a university degree, the intended or desired family size is generally around two children (Beaujouan and Berghammer 2019; Berrington and Pattaro 2014). In addition, the share of younger respondents who express an ideal or an intention to be permanently childless remains low in most countries

(e.g., Rybińska (2020) for the United States; Esteve et al. this volume). This evidence suggests that one of the key explanations for low fertility rates is the inability of women and men to realise their fertility plans, with the intentions-behaviour gap typically being larger in countries with very low fertility (e.g., in Italy, Greece and Spain) and among women with higher education (Beaujouan and Berghammer 2019). Albert Esteve et al. (this volume) argue that the gap is built over the life course, and is partly explained by less frequent and later partnership formation (see also Section 3 below).

In many countries, post-transitional fertility has been unstable, characterised by distinct waves of fertility declines and upturns over time (Sobotka 2017). These ups and downs of "rollercoaster fertility" are largely driven by changes in the timing of parenthood in response to economic shocks, changes in family policies and other factors; and do not affect the completed fertility rate, which generally follows a much more stable trend. As a result, period TFRs often send the wrong signal about the direction and the pace of fertility change, as well as about the differences in fertility levels between countries and populations (Sobotka and Lutz 2011). This fallacy of overinterpreting short-term period fertility shifts is also found in some contributions studying the changing links between selected determinants of fertility and fertility rates (e.g., Myrskylä et al. 2009).

Another key feature of post-transitional fertility is a shift towards entering parenthood at later reproductive ages that has been progressing in many countries without interruption since the 1970s (Sobotka and Beaujouan 2018). Anna Rotkirch (this volume) highlights the complex nature of fertility decisions today, which involve a much higher degree of ambivalence about when "it is safe and desirable to have children" and a longer list of "preconditions" for parenthood that have to be fulfilled before men and women are ready to have a child. Among these preconditions, finding the right partner and being able to live independently score especially high. Esteve et al. (this volume) argue that the timing of partnership formation is one of the key determinants of contemporary fertility differences. This link is most apparent in East Asian countries, where marriage remains a precondition for parenthood (Fukuda this volume). The rapid expansion of tertiary education, especially among women, and the increasing involvement of women in the labour force, have contributed to a sharp rise in the mean age at first marriage across the region (Cheng this volume, Fukuda this volume).

The ever-later timing of entry into parenthood, in combination with a rise in lifetime childlessness, indicate that women and men are spending increasing shares of their reproductive lives without children. For instance, in Japan and Spain, close to 40% of women currently remain childless at age 35 (Human Fertility Database 2020), a threshold at which infertility starts to increase (Leridon 2008). To account for both the changes in childlessness and the shift towards later parenthood, Ryohei Mogi and Michael Dominic del Mundo propose a new index of the average length of life women spend without children during their reproductive period (15–49): the *Expected Years Without Children* (EYWC). Focusing on women in eight countries born in the 1940s to the early 1960s, they show that first birth postponement was

the main driver behind the rise in the EYWC in Canada, the Netherlands, Norway, Sweden and the United States.

The increase in childbearing after age 35 has been fastest among childless women and women with one child. This implies that these women are at higher risk of being unable to realise their fertility plans due to infertility (e.g., Beaujouan et al. 2019). As Esteve et al. (this volume) highlight, fertility decisions are increasingly constrained by the ages of the prospective parents. Postponed parenthood is also linked to a rising reliance on assisted reproductive technology (ART), which is becoming an important means for achieving pregnancy among many women and couples past age 35. For instance, in Japan, the share of children born to women who had ART treatment jumped from 1.0% in 2000 to 2.7% in 2010, and to 6.0% in 2017 (own computations based on Ishihara et al. 2019). In Spain, 8.6% of all births in 2018 were to women who underwent ART treatment (computations based on Table 3.17 in Registro SEF 2018).

2.4 How low can fertility fall in post-transitional countries? What explains the decline in fertility to ultra-low levels?

Within the current variation in post-transitional fertility trends, demographers are especially concerned about the countries and regions with "ultra-low" or "lowest-low" fertility rates. The question of "how low can fertility fall" is both fascinating and relevant from the standpoint of governments, societies and policy-makers dealing with the likely long-term consequences of depopulation and population ageing. While some studies have tried to empirically determine the lower bound of period and cohort fertility (Golini 1998), a more plausible view suggests that there is no obvious limit to low fertility. At least from a period perspective, zero is the ultimate limit once reproduction is culturally determined (Lutz this volume). Equally important, also from the perspective of population projections, is the question of how long extreme low fertility is likely to last: Is it a transient phenomenon, merely driven by a temporary shift towards later parenthood, or is it likely to become a permanent feature of many societies? Lutz et al.'s (2006) *low fertility trap* hypothesis argues that in societies with a long-standing experience of very low fertility, the family size ideals of younger generations socialised in small families and in an environment with few children around could change, leading to a spiral of declining numbers of births, low family size ideals and very low fertility.

Currently, two broader regions, Eastern Asia and Southern Europe, are the "hotspots" of global low fertility, with the Republic of Korea (South Korea) achieving new lows in its period TFR almost every year: the TFR in the country dropped to 0.92 in 2019, and reached the even lower level of 0.72 in the capital city of Seoul (KOSIS 2020).[1] What are the characteristics of countries with very

[1] Based on trends in the absolute number of births in January–August 2020, which were down 9.5% compared to the same period in 2019, the TFR in South Korea is likely to drop below 0.85 in 2020.

low fertility? Table 1 summarises the selected features of period and cohort fertility in seven countries and territories in Southern Europe and East Asia: Greece, Italy, Spain, Hong Kong, Japan, South Korea and Taiwan. In each of these countries, the tempo-adjusted indicator of period fertility in 2016 and the completed fertility of women born in 1978 were above the recent conventional period TFR levels, signalling that the "ultra-low" fertility levels are partly fuelled by the ongoing postponement of parenthood. At the same time, the tempo-adjusted period fertility rates and the completed fertility rates in these countries generally reached levels of around 1.4–1.5. Thus, regardless of which indicator is used, fertility in these countries is low, with the completed fertility rate reaching the lowest level globally in Hong Kong (1.25), followed by Spain (1.36). The low mean family size in these societies is due to a combination of a high share of women remaining childless (reaching 28% in Japan and 30% in Hong Kong) and a high share of women having only one child (see also Zeman et al. 2018). Southern European and East Asian societies are also characterised by a pattern of late parenthood, with the mean age at first birth among women surpassing 30 years, and reaching close to 32 years in South Korea.

What are the key factors contributing to "ultra-low fertility"? Alice Cheng (this volume) provides a review of the institutional factors that underlie very low fertility in East Asia, with a particular focus on Japan, Hong Kong, South Korea and Taiwan, but also incorporating data and literature on China (see also Raymo et al. 2015). Cheng highlights the historical and cultural roots of ultra-low fertility in the region, with traditional Confucian ideology placing a strong emphasis on formal academic attainment. Moreover, Confucianism promoted a patriarchal view of male and elder dominance, and stressed women's responsibilities to provide care as part of their roles as wives, mothers, and daughters. Female empowerment in education and employment, together with long work hours and rigid labour market structures (Brinton and Oh 2019), clash with these traditional norms and expectations: the "patriarchal cultural and family systems of East Asia are maladapted to women's rising status and economic independence" (Cheng, this volume: 84).

An important feature of East Asian cultures is their low acceptance of unmarried cohabitation, of non-traditional family forms and, even more so, of childbearing outside marriage (Fukuda this volume; Cheng this volume; Raymo et al. 2015). The prevailing gender inequalities, the rising economic uncertainty, the high direct and opportunity costs of childbearing – especially for women – and the notion that marriage and childbearing are "too stressful" and involve "too much personal sacrifice" (Cheng this volume), have led to both the erosion and the postponement of marriage. Cheng argues that "the social mentality and the prevailing norms about marriage and childbearing are incompatible with the rising agency of women" (p. 110). Stuart Gietel-Basten (this volume: 40) refers to the "cultural and institutional grip that older generations have on the young", which sustains gender inequality. As childbearing is exclusively linked to marriage, less frequent marriage, later marriage and the rising instability of marriage have negatively affected fertility rates in East Asia (Fukuda this volume). In addition, the strong focus on the

Table 1:
Selected characteristics of period and cohort fertility in Southern European and East Asian countries and territories with very low fertility

	Southern Europe		
	Greece	**Italy**	**Spain**
Period TFR (2019)	1.34[1)]	1.29	1.23
Tempo-adjusted TFR (2016)	1.49	1.47	1.43
Completed TFR (cohort 1978)	1.51	1.43	1.36
Childlessness, cohort 1978 (%)	24	21	25
Women with one child, cohort 1978 (%)	–	–	28
Mean age at first birth (2018)	30.4	31.2	31.0

	East Asia			
	Hong Kong	**Japan**	**South Korea**	**Taiwan**
Period TFR (2019)	1.05	1.36	0.92	1.05
Tempo-adjusted TFR (2016)	–	1.54	1.46	1.36[2)]
Completed TFR (cohort 1978)	1.25[3)]	1.47	1.53	1.58[4)]
Childlessness, cohort 1978 (%)	30[3)]	28	18	18[4)]
Women with one child, cohort 1978 (%)	–	20	24	23[4)]
Mean age at first birth (2018)	–	30.2	31.6	30.0[5)]

Sources: Human Fertility Database (2020); national statistical offices (for the TFR in 2019); European Demographic Data Sheet (2020) (tempo-adjusted TFR and completed TFR in Southern Europe and Japan); Census and Statistics Department Hong Kong (2020; Tables 6 and 7).
Notes: Data on completed TFR, childlessness and the share of women with one child are based on observed fertility by age 40 and estimated (projected) fertility past that age. 1) Preliminary estimate based on absolute changes in the number of births; 2) data for 2012; 3) data pertain to the 1979 cohort (based on Tables 6 and 7 in Census and Statistics Department Hong Kong (2020)); 4) data pertain to the 1974 cohort; 5) data for 2014.

academic achievements of children has increased the investments of time and money parents are expected to make in their children's education, including in extended extracurricular activities. This "educational arms race" results in lower fertility intentions and reduced fertility (Cheng this volume).

By contrast, in Southern Europe, the initially close link between marriage and childbearing has eroded fast. However, Southern European and East Asian societies share the trend towards a pattern of late independent living and partnership formation among young adults (e.g., Esteve et al. this volume). The late transition to residential independence is fuelled in part by extended education, but even more so by the high and rising costs of housing and the high levels of economic uncertainty among young adults, with many facing unemployment, or employment that is poorly paid or with a non-standard contract. While economic uncertainty has affected young adults and their fertility decisions across all highly developed countries, it

has had the most "scarring" effects in South-Eastern, Eastern and Southern Europe (Adserà 2011), especially in the wake of the financial crisis of 2007-2012 (Comolli 2017; Matysiak et al. 2020). Southern Europe is also characterised by relatively underdeveloped family policies, with more government resources being spent on the elderly, and a large share of the burden of family care responsibilities being shouldered by kinship and family, and especially by women (Cooke 2009; Pailhé et al. 2019).

2.5 What factors contribute to the changes in and the diversity of post-transitional fertility?

Over the past decade, numerous studies have discussed and evaluated the factors and institutional conditions that affect post-transitional fertility levels, fertility trends and their variation, while often proposing new conceptual frameworks. Five broader, partly interrelated factors – i.e., economic uncertainty, gender egalitarianism, changing educational and social stratification in fertility, the impact of migration and institutional support provided to families – feature prominently in these debates. Adverse economic and labour market conditions have been repeatedly shown to have a negative impact on fertility intentions (Fahlén and Oláh 2018; Busetta et al. 2019; Vignoli et al. 2020a) and fertility (Adserà 2011; Sobotka et al. 2011; Comolli 2017). Over time, the conceptualisation of uncertainty has widened beyond the impact of economic shocks. One strand of research has documented the impact of delayed economic independence, more precarious jobs, declining relative income and the general increase in pressures and uncertainties among the younger generations (Mills and Blossfeld 2005; Sanderson et al. 2013). Recently, Vignoli et al. (2020b) extended the concept of uncertainty to incorporate the "imagined futures": i.e., perceptions and narratives of the future that may be disconnected from an individual's current situation.

From a different perspective, Nicolò Cavalli (this volume) argues that demographic behaviour is strongly future-oriented, and that considering the role of "time preferences can add another theoretical micro-foundation to the mechanisms that link individual fertility decisions to institutional factors that operate at the macro level" (p. 257). His main argument, grounded in the concepts of *hyperbolic (time) discounting*, is built upon two key insights on decision-making: first, that individuals have a preference for earlier rather than later gratification, opting for rewards that are smaller, but occur earlier; and, second, that a conflict between current and future preferences results in people consuming more at present than initially planned (thus "discounting", or penalising, future rewards). Cavalli hypothesises that societies that are more future-oriented are likely to show a lower "bias towards the present", with families tending to invest more in the quality of their children, resulting in lower fertility rates. Empirically, this hypothesis is tested by constructing a *Future Orientation Index* (FOI) based on worldwide *Google* queries. The results of this analysis confirm that there is a negative correlation between future orientation and

the total fertility rate, which flattens out at high levels of future orientation. It would be worth expanding this analysis to fertility timing: i.e., future orientation is likely to lead to more careful planning of births among couples, which may contribute to the fertility postponement observed in many countries.

The structural/economic perspectives on fertility have often neglected the impact of massive changes in women's educational levels and economic achievements over the last half a century. Mills (2010) highlights the complexity of arguments linking different micro- and macro-level perspectives on gender equality and fertility, which focus on issues such as the division of household work and childrearing among couples, but also on institutional factors that lead to unequal opportunities and participation in education, employment and social and political life. Esping-Andersen and Billari (2015) and Goldscheider et al. (2015) link the broader trend towards gender equality both within households and in public institutions to the transformations in fertility patterns in the past decades. The *gender revolution* framework proposed by Goldscheider et al. (2015) suggests that an initial trend towards institutional gender equality, marked by a rapid rise in higher educational attainment among women and a sharp increase in women's participation in employment, resulted in "less family" and low fertility, as women's labour market activities remained incompatible with their family roles. This incongruence between rising opportunities and aspirations in the public sphere and rigid norms and expectations in the domestic sphere is especially sharp in East Asia today (Cheng this volume). According to Goldscheider et al. (2015), the "second half of the gender revolution", which is driven by the spread of gender egalitarian attitudes and practices within the household, will eventually result in a return to "more family", and, thus, to a rise in fertility and marriage rates. Furthermore, changes in the structure of economic opportunities and improvements in the compatibility of family and career for highly educated women, supported by family policies, could lead to a reversal of the negative association between education and fertility among women. Trude Lappegård (this volume) discusses these arguments with reference to the unexpected recent decline in fertility in the Nordic countries, which are characterised by high levels of both institutional and domestic gender equality. She argues that gender equality must be considered within a wider context of a "changing economy, globalization, and increasing economic uncertainty" (p. 45), and linked to systems of social stratification. Whether gender equality positively affects fertility will depend on the responses of different socio-economic groups (see also Section 3 below).

Across the low-fertility countries, the evidence on the changing social stratification of fertility is mixed. For the Nordic countries, Jalovaara et al. (2019) document that, with the exception of Finland, completed fertility has converged among women across different educational groups born in the late 1960s and early 1970s. In Denmark and Sweden, childlessness has risen sharply among women with low education, reaching much higher levels than among women with medium or high education. Past data for countries in Southern, Central and Eastern Europe, as well as for the United States, Australia and the United Kingdom, show the persistence of a negative education gradient in fertility among women born in the 1960s and 1970s

(e.g., Berrington et al. 2015; Sobotka et al. 2017; Zang 2019; Gray and Evans 2019). One factor that continues to contribute to lower fertility among highly educated women is their late family formation. Women and men tend to postpone the first birth until after they finish their studies, and educational expansion is the main driver of the trend towards late parenthood across the highly developed countries (Ní Bhrolcháin and Beaujouan 2012).

In the context of continuing education expansion, Michaela Potančoková and Guillaume Marois evaluate the importance of accounting for women in education in their microsimulation projection model for 28 European Union countries (including the United Kingdom): when educational enrolment is included, the projected EU-wide TFR is lower than it is in the scenario that accounts for educational attainment, but not enrolment. Their analysis reveals, however, that migration will be the major source of heterogeneity, as it will have strong effects on fertility, the number of births, population size and population distribution across the European Union. The impact of future migration is most clearly illustrated in the *high immigration scenario*, which assumes that there will be a doubling of the inflow of immigrants from outside of the European Union, roughly corresponding to current levels of immigration to Canada. When contrasted with the scenario in which recent (2010–14) levels of immigration continue, the *high immigration scenario* would result in a larger female population of reproductive ages, which would, in turn, lead to higher fertility and a steadily increasing number of births, reaching 34.9 million in 2055–59 (vs. 24.8 million in the baseline scenario).

From a different perspective, Alicia Adsera (this volume) argues that return migrants and transnational migrants may contribute to fertility declines in their countries of origin. The flow of financial resources via remittances should ease the pressure on local families to put their children to work, and encourage them to invest in their children's education. At the same time, cheap and accessible communication technologies, including social media, should speed up the transmission of information, and foster new norms about family planning, women's empowerment and smaller family size ideals.

The impact of uncertainty, gender equality, migration and social stratification on fertility is altered by family-related policies and the overall character of the welfare state – which, in turn, affect educational and labour market systems (Neyer 2013). Across the low-fertility countries, governments have been investing more resources in families. However, the evidence on the effects of family policies on fertility is mixed, suggesting that their main impact is on the timing and spacing of births, often fuelling short-term cycles of baby booms and busts (Gauthier 2007; Thévenon and Gauthier 2011; Luci-Greulich and Thévenon 2013). Especially questionable are the effects of family policies designed with explicit pronatalist targets, which are often poorly conceived; have short-term aims; and are usually based on simple indicators affected by changes in the timing of births, especially the period TFR (Sobotka and Lutz 2011; Sobotka et al. 2019). In countries with comprehensive family policies, particular attention has been paid to policies supporting the reconciliation of work and family (OECD 2011), which are most beneficial to highly educated women

(McDonald and Moyle 2019). Family policies might have neglected some of the needs and preferences of less educated women and men, who often have low-paid and unstable jobs, as well as more complex family trajectories and configurations (see also Lappegård this volume). In most countries, family policies have not yet fully "caught up" with the current diversity of family forms and living arrangements, and there is a need to extend more social protection rights and welfare benefits to children in non-traditional family configurations (Miho and Thévenon 2020).

3 Demographic debate: what is the most important factor likely to influence future fertility?

The authors who were invited to contribute to the *Demographic Debate* section were asked to discuss the following question: "What is the most important factor likely to influence future fertility trends and why?" These contributions were largely drafted before the COVID-19 pandemic started affecting our societies, and they cover a broad range of factors relevant in fertility decisions, either globally, or in selected countries and regions. I have reflected upon some of these answers above. Here, I summarise the key themes and ideas.

At a general level, the contributions by Wolfgang Lutz and Anna Rotkirch argue that the changes that happen in our minds – i.e., *changes in reproductive ideals, plans, desires and preferences* – will be the key drivers of future fertility. Rotkirch highlights that the "wish to have a child" is the main determinant of fertility behaviour. Fertility preferences may change as a result of economic and existential uncertainty, and of lifestyle changes (see Section 4 below).

In the context of relatively high fertility *in Sub-Saharan Africa*, the essays by Alicia Adsera and Wolfgang Lutz stress *the paramount role of education* both in driving the shift towards smaller family size ideals, and in empowering women. This process of empowerment includes ensuring that women have better knowledge of and access to contraception and reproductive health services, but also that women are able to persuade their partners and extended family to allow them to pursue their family size desires (Lutz this volume). The necessity of empowering women to overcome the barriers and obstacles to realising their own fertility desires is also emphasised by Stuart Gietel-Basten. What are the conditions needed for educational expansion and for achieving a smaller ideal family size in the region? Alicia Adsera highlights the importance of *governance and political stability*, with wars and conflicts leading to displacement, less access to education, earlier marriage and higher fertility. She discusses the impact of resources in the form of remittances, and of the new values disseminated by migrants living in more affluent countries with lower fertility.

In low-fertility societies, Albert Esteve, Diederik Boertien, Ryohei Mogi and Mariona Lozano argue that the *intensity and timing of partnership formation* are the most important factors in the variation in contemporary fertility, and that other social and economic factors primarily affect fertility by influencing the number of

people who live independently and have a stable partnership. The importance of union formation, and specifically of marriage, is also discussed by Setsuya Fukuda. In the context of Japan and other East Asian countries, marriage is perceived as a precondition for childbearing, as reproduction occurs almost exclusively within marriage. At the same time, the share of the population who are unmarried or non-partnered has risen, with a majority of single men and women aged 18-34 reporting that they are not in a dating relationship. Moreover, marriages have become less stable, and the "prevalence of divorce and its consequences for remarriage and fertility have become critical factors to consider" when evaluating the potential impact of marriage on future fertility (p. 75).

The role of *gender egalitarian values and behaviour* is highlighted in the contributions by Trude Lappegård and Stuart Gietel-Basten. Gietel-Basten argues that if the next generation manages to "draw up a new reproductive contract based on *equity* (. . .) the biggest hurdle to the actualisation of reproductive preferences will be removed, and this shift could, in turn, have a dramatic impact on fertility rates in the future" (p. 41).

The joint forces of economic uncertainty, rising social status disparities and the shift towards more egalitarian gender relations are likely to lead to a reversal of *education and social status stratification in marriage and fertility rates.* Setsuya Fukuda suggests that education will become one of the key factors influencing marriage in East Asia, as future marriage trends will be driven by rising labour market uncertainty and non-standard employment, which could erode marriage opportunities, especially for the less educated; and by more equal sharing of gender roles, which could facilitate marriage among better educated women. In a similar vein, Trude Lappegård expects that the eroding economic position of the lower educated and the rising preference for a partner with high earning potential and egalitarian attitudes will mean that "finding a partner and establishing a long-term relationship is likely to be especially difficult for both men and women with low education" (p. 46). As a result, individuals with low education and poor job prospects will increasingly postpone parenthood, and will thus have fewer children. Wolfgang Lutz anticipates that people with intermediate levels of education and income in particular will struggle to combine work and family, and to make ends meet. By contrast, high educational attainment is strongly associated with characteristics that will empower women and couples, giving them skills and resources to better combine career, leisure and family, and "to come closer to their ideal of having two children than women with intermediate income levels" – which could, in turn, lead to a U-shaped gradient in fertility by education (p. 68).

What are the main *policies that could support future fertility?* Discussions of policies occupy surprisingly little space in the contributions in this volume. Alicia Adsera highlights the importance of migration policies, which will determine the size and the composition of migrant flows into the more developed countries, and will, in turn, affect the integration of migrants, and their subsequent fertility and marriage behaviour (see also Potančoková and Marois). Albert Esteve and colleagues emphasise the impact of policies that support young adults in living independently and forming a stable partnership, including policies that improve

labour market opportunities and access to childcare and housing. Setsuya Fukuda stresses the importance of policies supporting female employment and work-family balance in East Asia. In a broader perspective, Stuart Gietel-Basten suggests putting gender equity at the heart of the reproductive contract for the 21st century (p. 41).

4 Looking into an uncertain future

The past decade has seen unexpected fertility shifts and reversals in many regions. In particular, the contributions commenting on the Nordic countries highlight the surprising and at times dramatic fertility declines that continued during the economic recovery after 2012, and that challenge the established explanations of fertility change and variation (contributions by Adsera, Lutz and Rotkirch). Arguably more consequential is the return and the persistence of "lowest-low" fertility in Southern Europe and East Asia, where fertility rates have not recovered in the aftermath of the Great Recession, and where the continuing postponement of parenthood leaves women and couples with an ever-narrower window for a fertility recovery in the future.

Are we experiencing yet another temporary shift in fertility, similar to past swings in fertility rates in countries such as Denmark and Sweden? Or are we entering a new era of lower reproductive aspirations and depressed fertility? The jury is still out, but there are many signs that the reproductive landscape is being redrawn and the contours of the new one are only slowly emerging. One of the few certainties is that sustaining replacement-level fertility is not on the menu of choices and options in this new landscape.

The media, especially in the United States, has reported numerous shifts in the lives of the younger generations growing up in the era of social media (Twenge 2017). It has, for example, been observed that compared to older generations, today's young people tend to have fewer and later sexual and dating relationships (*The sex recession*; Julian 2018); and they are less likely to engage in risky behaviours, such as smoking and excessive alcohol and drug consumption. However, young people are also more anxious and sleep-deprived (*Have smartphones destroyed a generation?*; Twenge 2017); and, crucially, they face a crisis of reproduction (*The end of babies*; Sussman 2019). In her insightful contribution, Anna Rotkirch, draws from qualitative and quantitative research in Finland to provide a compelling outline of the new landscape of reproduction marked by new pressures and uncertainties, less certain reproductive preferences and a less positive image of parenthood. "Traditional" explanations based on economic and policy factors are not sufficient to explain recent fertility declines, as the lives of young Finns "have not grown objectively worse (…) family policies and leave benefits remain generous, and levels of gender equality have increased" (p. 54). New uncertainties and worries about the future (see also Vignoli et al. 2020b) are partly fuelled by social media and concerns about issues like climate change. Moreover, young adults are increasingly reluctant to give up the joys of their

childfree lifestyle: as Rotkirch argues, "having a child can be seen as a sacrifice, while remaining childless is associated with having access to the positive aspects of life (sleep, sex, career)" (p. 57).

The ongoing coronavirus pandemic is likely to add yet another layer of insecurity, and will accelerate the trend towards putting off parenthood (Lindberg et al. 2020; Aassve et al. 2020). In Southern Europe and parts of South-Eastern and Eastern Europe, the disruption caused by the pandemic will further deepen the existing economic and labour market challenges faced by young adults in countries with high unemployment, unstable jobs and limited family policies. The lingering effects of the Great Recession and the unfolding effects of the COVID-19 pandemic are likely to combine into a perfect storm that will disrupt the lives of younger generations, and will bring about a fertility shock. In East Asia and elsewhere, the pandemic may strengthen the trend towards having fewer social contacts, less in-person interaction, fewer partnerships and fewer and later marriages (Settersten et al. 2020). Even if the effects of the COVID-19 pandemic prove to be mostly temporary, many countries are likely to experience unprecedented drops in fertility rates, with some seeing their total fertility rate falling below the threshold of one. Our established terminology for "lowest-low" or "ultra-low" fertility might become insufficient to describe these new fertility lows.

It is unclear whether the effects of the pandemic are likely to persist over the longer term, fundamentally reshaping our social relationships and family life (Settersten et al. 2020). Likewise, it is not yet known whether the pressures in the lives of the younger generation and their generally more sceptical attitudes towards parenthood – illustrated in the examples from Finland and the United States – can be generalised to all low-fertility countries. Stuart Gietel-Basten paints another possible future in which Millennials and Generation Z reshape the economic and social system in more equitable and fairer ways that could make societies more friendly to families and children. However the future turns out, research on fertility across time and space, and on the forces affecting fertility change and variation, is likely to remain relevant, exciting and surprising in the decades to come.

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DEBATE

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International political economy and future fertility trends

Alícia Adserà[1,*]

When I was asked what would be *the most important factor likely to influence fertility in the near future*, my first inclination was to focus on countries experiencing very low fertility, particularly European and East Asian nations. Out of the multiple factors that are bound to have large effects on childbearing behaviour in low-fertility advanced nations – and, eventually, in less developed settings as well – I wish to highlight three examples. First, the continuous postponement of first births (and the associated challenges for fecundity), combined with the growing role of artificial reproduction techniques (ART) and genetic manipulation, could raise new ethical issues surrounding births. Second, a deepening of the current structural changes in the labour market, which have led to reductions in jobs in mid-skilled occupations and increases in more unstable positions at the low end of the market, may lead to a further flattening or even a reversal of the educational gradients of fertility (Adserà 2017). Third, the digitalisation of society, which is characterised by the dominance of social media and the internet as an information source, may affect childbearing decisions differentially across socioeconomic groups and origins. Indeed, recent research suggests that the internet is already having a significant effect on fertility patterns; although determining which mechanisms are at work in this association remains an open research agenda (Billari et al. 2019).

Nevertheless, as policy efforts to raise fertility in low-fertility countries have shown, the margins for changing fertility levels in those settings are limited (Gauthier 2007). When looking at the current levels across the world, we can see that the largest potential margins of change in overall fertility levels are in Sub-Saharan Africa. Table 1 shows UN Population Division estimates of the total fertility rate by Sustainable Development Goal regions. Africa, Western Asia, South Asia, and Central Asia are the only regions that are expected to end this decade with fertility rates above replacement level and, within those regions, Sub-Saharan Africa is a clear outlier, with an average total fertility rate of close to five.

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Table 1:
Total fertility rate by Sustainable Development Goal regions

Sustainable Development Goal (SDG) regions	1950–1955	1975–1980	2000–2005	2015–2020
Sub-Saharan Africa	6.51	6.78	5.64	4.72
Northern Africa and Western Asia	6.57	5.75	3.20	2.93
Central and Southern Asia	6.00	5.27	3.21	2.41
Eastern and South Eastern Asia	5.69	3.30	1.82	1.83
Latin America and the Caribbean	5.83	4.44	2.49	2.04
Australia/New Zealand	3.27	2.02	1.80	1.84
Europe and North America	2.80	1.92	1.60	1.66

Note: *World Population Prospects 2019*. File FERT/4: Total fertility by region, subregion, and country, 1950–2100 (live births per woman). Department of Economic and Social Affairs, U.N. Population Division.

In an excellent paper on the fertility transition in Africa, Bongaarts (2017) examined the distinct position of African countries in this process, which was previously mentioned by Caldwell et al. (1992). The fertility transition in African countries happened later (around the mid-1990s) than it did in other developing countries. Moreover, the transition in African countries occurred at lower levels of development than it did elsewhere, and it progressed at a very slow pace. As Bongaarts' (2017) estimates show, African countries continue to have both lower contraceptive use and higher desired fertility than other similarly developed countries.

Among the multiple coexisting factors that account for this distinct position, I have chosen to focus in this short note on how political stability and the international political economy may affect African fertility (and global fertility), both currently and in the near future. I briefly discuss three pathways: (1) the impact of the region's violence and weak governance on the pace of its fertility transition; (2) the effect of both immigration policies and the size of the welfare state in the major destinations of African migrants on migrant integration and, arguably, on the fertility trends in those destinations themselves; and (3) the influence of remittances and return migration (whether permanent or temporary) on fertility norms in the origin countries.

1 Political institutions, leadership, and violence in high-fertility countries

Traditional pronatalist social, economic, and cultural practices have been invoked to explain why fertility remains so high in many Sub-Saharan countries, and why it has been decreasing so slowly since the start of the demographic transition in

the mid-1990s in many of these countries (Caldwell et al. 1992; Bongaarts 2017). Even though Bongaarts (2017) notes that relatively low rates of contraception use coexist with a larger desired family size in Sub-Saharan Africa, there is evidence of a substantial unmet need for contraception in the region (Bongaarts and Casterline 2012). As studies conducted in a handful of countries have shown, national support for family planning and political will among top policy-makers are crucial to the success of efforts to reduce fertility (Cleland et al. 2006). May (2017) has described in detail the lack of leadership among some political elites around issues of family planning, as they often conform to their constituencies' existing pronatalist views.

It is also clear that in some of these countries, weak governance hampers not just access to contraception, but, more importantly, human capital investments (both in education and health) that are associated with lower morbidity and mortality, less risky behaviour, and higher levels of agency among women (Lutz and Skirbekk 2014). In most African societies, contraceptive demand is greater and the desired family size is smaller among the more educated classes (Bongaarts 2010).

The ongoing political instability, wars, and violence in some parts of the region limit the territorial access of both public and private organizations seeking to provide family planning and health services, and to improve the educational infrastructure. In addition, the people who have been displaced as a result of this instability – particularly those in refugee camps – have traditionally been underserved. In some contexts, wars and forced displacement have led to earlier marriages. While the aim of such arrangements is ostensibly to protect young girls, early marriage can have a detrimental impact on women's human capital formation, and lead to early fertility.

Whether the region enters into a virtuous circle of higher human capital investment, which would likely speed up a fall of fertility rates, will depend on the extent to which political instability decreases and political leadership and governance improve in the coming years.

2 Immigration policies and the welfare state in migrant destinations

Confronted with low fertility and rising dependency ratios, most advanced countries face a few policy options to sustain their relatively generous welfare states. Boosting fertility rates in these countries via direct policies has proven difficult (Gauthier 2007). Alternatively, policies designed to increase labour productivity (via capital deepening and improved skills) or adjust the generosity of the welfare state have sparked long-running debates. Finally, larger migration flows could temporarily reverse the trend in dependency ratios and rejuvenate the population. The demographic and economic pressures in Sub-Saharan Africa in particular are generating a large pool of potential migrants.

Policies in the receiving countries will determine the size of migration inflows, as well as their demographic and political consequences. On the one hand,

well-integrated migrants who contribute to the productivity of the receiving economy should improve the ability of the country to sustain welfare policies, including family policies that support fertility. On the other hand, how natives perceive the impact of the new migrant flows into their economies will affect the political economy of the receiving country. Fears of competition in the labour market or concerns about the dilution of national values may cause protectionism and populism to rise. As migration increases, political support for welfare programs may decline if natives are afraid that migrants will overuse these services (Senik et al. 2009). Thus, there is a danger that a race-to-the-bottom dynamic will emerge that both hampers the ability of newcomers to integrate, and threatens existing family policies that ease work-family trade-offs for natives in the destination countries. As part of ongoing research, Adserà et al. (2019) have found that especially among high-skilled migrants, having access to private employment in the destination country, rather than having access to welfare benefits, largely explains the recent migration flows into the OECD (Organization for Economic Co-operation and Development) countries.

How well migrants integrate into society in general – whether through intermarriage or the adoption of local social norms – is contingent on their economic opportunities, as well as on natives' attitudes. To date, there is general evidence that the fertility levels of migrants and natives are converging, albeit with some heterogeneity across origin groups. Kulu et al. (2019) have provided one of the most recent overviews of the research in this area. If it is indeed the case that migrant fertility tends to adapt to local trends within one generation or less, it is unlikely that higher levels of migration alone will boost fertility rates in low-fertility countries. Sobotka (2008) has shown that the overall impact of migrant populations on fertility rates in European countries has not been as large as a casual reading of some press reports or political discourses would suggest. Moreover, the degree to which migrants adapt to social norms and fertility behaviour in the destination country will have a bearing on the norms that they transmit to their peers in the country of origin, as I explain below.

3 Reverse development and fertility

Both remittances and ideas brought back into the country by natives with migration backgrounds may speed up fertility changes in the countries of origin. Financial remittances constitute a large share of GDP in many source countries with a large diaspora. These transfers are instrumental to smoothing consumption and increasing savings in those countries. The reduction of uncertainty and the overall economic improvement in remittance recipient households (and communities) should lessen pressures on families to put children to work, and should encourage educational investments.

In addition to financial remittances, social remittances in the form of transfers of information, skills, and social capital from receiving communities are another

important contributor to development in the sending countries (Levitt 1998). Both return migrants and transnational migrants play an important role in the transmission of new values to their communities of origin. In recent years, cheap and accessible communication technologies have facilitated the emergence of the transnational migrant as an individual who builds networks of economic and social connections with his/her country of origin while settled abroad (Portes 1999). Social remittances should facilitate the convergence of social norms, gender roles, and women's empowerment in the form of higher female labour market participation and educational levels. Having first-hand information about family planning from peers should help lower barriers to contraception uptake by alleviating fears of experiencing social disapproval and side effects when using contraception, and by easing within-couple negotiations (Cleland et al. 2006). Furthermore, calls for stronger democratic values in source countries that are informed by the experiences of the countries' migrants in their receiving communities may persuade authoritarian regimes to improve their policies in areas such as human capital formation.

Beine et al. (2013) show some degree of convergence in fertility levels between many sending countries and major destinations of their migrants. We should expect this transmission process will increase further via the use of social media the internet and continuous contact with migrant relatives.

Overall, the current trends in the international political economy seem to offer more opportunities than threats for the progress of women. Provided there is a reduction in the level of violence and improvements in governance that boost human capital investment in high-fertility countries, as well as a gradual convergence in gender norms across the globe, we should observe an increase in the pace of fertility decline in high-fertility regions among the more educated younger cohorts – and, as a result, a decrease in average fertility worldwide.

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Moving out the parental home and partnership formation as social determinants of low fertility

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1 The challenge

The study of fertility across societies has been a core subject of demography, and is one of the main areas of theory development. As countries went from having fertility well above the replacement level to having fertility near the replacement level (2.1 children), one of the most widely accepted theoretical frameworks in demography emerged: the demographic transition. This transition was primarily driven by the social, health, and economic transformations associated with the general process of modernization (Notestein 1953; Lee 2003). But in many countries, fertility continued to decrease, falling to below the replacement level. The second demographic transition (SDT) was proposed to explain these changes (Van de Kaa 1987; Lesthaeghe 2014). The SDT placed more emphasis on ideational and cultural changes than on structural factors. Today, fertility below the replacement level is observed in virtually all high-income countries, and is spreading rapidly to other areas of the world. In 2017, 96 out of the 217 countries covered by the World Bank data reported total fertility rates of below 2.1 children per woman. Understanding the variations in fertility trends across these countries poses a new challenge for demography. To meet this challenge, we stress the need to identify and quantify the relative importance of the proximate social determinants of low fertility. We suggest that researchers investigating this issue pay particular attention to the effects of moving out of the parental home and partnership formation.

We argue that the broad social, cultural, and economic forces that were cited to explain the occurrence of the first and second demographic transitions do not necessarily suffice to explain the variations in fertility across countries and time after these transitions have taken place. Neither the idea that further development will eventually reverse the declining trend in fertility (Myrskylä et al. 2009), nor the abundance of micro-level studies on the many factors that are associated with childbearing (Balbo et al. 2013), have yielded convincing explanations for why

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childbearing behaviour varies across low-fertility contexts. The idea that lowest-low fertility was just a stage in a process that would eventually lead to a recovery of fertility driven by advances in development or changes in gender relationships (Myrskylä et al. 2009; Goldscheider et al. 2015; Esping-Andersen and Billari 2015) has been challenged by recent declines in fertility in the alleged forerunner countries (e.g., Sweden and Norway). At the micro level of analysis, the growing availability of longitudinal data and the increasing sophistication of methods have resulted in an accumulation of findings documenting "causal" mechanisms affecting childbearing behaviour (Balbo et al. 2013). However, most of these findings have come from a selected group of countries (e.g., Germany, the United Kingdom, Nordic countries) for which data are available. Most importantly, it is not always clear how much these factors contribute to overall fertility levels at the macro level – and it is even less clear how much they contribute to cross-national differences in fertility rates.

To gain a better understanding of cross-national variations in low-fertility countries, we should aim to decompose cross-national variations in fertility rates based on a renewed set of proximate determinants of individual fertility decisions. Such an effort will require us to identify the proximate determinants of fertility at the individual level, and to quantify their contributions to the aggregate measures of fertility. We will also need to develop a broader understanding of how fertility decisions are constrained by desires and preferences for childbearing (and their importance relative to other life plans and projects), the biological limits to reproduction, and the resources and conditions required for achieving these goals. We argue that decomposition and standardization techniques can help us bridge the gap between the micro and macro levels of analysis when investigating how social institutions and national cultures penetrate the most personal aspects of peoples' lives. In the next section, we outline an analytical framework that may prove helpful in structuring this kind of analysis.

2 A tentative framework

We would like to suggest some basic elements and considerations that should be included in an analytical framework of below-replacement fertility in high-income countries. The framework proposed by Bongaarts is, of course, an inescapable point of reference for this effort (Bongaarts 1978). However, in the below-replacement era, several of the proximate determinants of fertility cited by Bongaarts have become less relevant (e.g., age at first intercourse, breastfeeding periods), while others remain just as important (e.g., fecundity and health). Here, we would like to start by emphasizing the following determinants.

First, fertility continues to be limited by *fecundity*. Assisted reproduction has extended the range of ages at which women can reproduce, but these extensions are more modest than the extensions of other social (e.g., expected age at first partnership or childbirth) and biological limits (e.g., life expectancy) that have taken place in recent decades. Thus, fertility decisions continue to be clearly constrained

by age. Whereas age 50 is conventionally adopted as the end of a woman's reproductive years, problems with conception and the viability of pregnancies tend to emerge at much younger ages. The continued postponement of fertility decisions is in direct conflict with the ability to get pregnant after a certain age.

Second, the vast majority of children in low-fertility countries are wanted children. Women and men have control over their fertility decisions due to the widespread use of contraception and, in some countries, legal abortion. However, many women and men do not end up having all of the children they claim they would like to have. Three indicators summarize people's *preferences regarding childbearing*: ideal family size, ideal age at first birth, and voluntary childlessness. The data from low-fertility countries systematically show that the observed fertility level is below the ideal fertility level of around two children per woman, which has been constant over time and across Western countries (Sobotka and Beaujouan 2014). When available, the data on preferences regarding parenthood timing in low-fertility counties indicate that the normative age at first birth is rarely below 25 years (Testa 2007). Younger men and women may have plans to become parents in the future, but they do not necessarily intend to have children soon. Finally, it appears that less than 10% of women are voluntarily childless (Kreyenfeld and Konietzka 2017). These findings clearly indicate that the observed fertility trends are not in line with fertility preferences. Which determinants contribute to this gap between observed and desired fertility? How is this gap built over the life course, and how do differences in individual life courses accumulate to create cross-national differences?

To answer these questions, it is crucial that we identify the key period in people's lives in which cross-country differences in fertility can arise. This period is defined by two age limits: the normative age at first childbearing at the lower end (i.e., the point at which people are willing to start having children), and the biological limits of reproduction at the upper end (i.e., the point at which a woman is no longer fertile). The existing evidence from high-income countries with below-replacement-level fertility indicates that cross-national differences arise between ages 25 and 40, and specifically among women in their thirties. Hence, assuming that science does not produce any major breakthroughs that extend the age limits of human reproduction, it appears that the window of time in the life course in which childbearing typically occurs is 10 to 15 years.

It is within this age range that we have to identify the additional proximate determinants of individual fertility, and quantify their contributions to macro-level rates of fertility. We argue that the two determinants that contribute the most to low fertility within this age range are *leaving the parental home* and *partnership formation*. Even today, the vast majority of births in high-income countries take place among co-residing couples, either married or cohabiting, who are economically independent and have their own housing. There are clear interactions between these two determinants. While a young person may leave the parental home and form a union at the same time, the likelihood that these two life transitions will coincide is declining (Buchmann and Kriesi 2011). There are also individuals who have a stable

partner, but do not live with their partner (Levin 2004). We argue that partnership formation is the key element to focus on when studying determinants of fertility. While recent research has examined couple dynamics and gender relationships *after* union formation and their influence on fertility decisions, we hypothesize that the intensity and timing of partnership formation are the most important factors to consider when seeking to understand cross-national variations in fertility.

Both moving out of the parental home and forming a stable partnership have to be seen from a life course perspective, and are, therefore, age dependent. If people achieve certain conditions before or after they are in the range of ages for having children, as determined by normative and biological factors, it might have no influence on their fertility (Beaujouan et al. 2019). The literature on transitions to adulthood has documented extensively how these transitions affect fertility (e.g., Baizán et al. 2003), but it has not quantified how these transitions affect the cross-national differences in fertility rates we observe today. We hypothesize that the differences in fertility rates across low-fertility countries would be much smaller if all of the countries had similar rates of partnership formation and independent living between the ages of 25 and 40. A proper decomposition of fertility rates by the ages associated with and the duration of independent living arrangements and stable partnerships would be an important first step towards confirming our main hypothesis. It is through living independently and having a stable partnership that other social and economic changes affect fertility. For instance, cross-country differences in patterns of independent living and partnership formation might mirror cross-country differences in structural dynamics, such as labour market opportunities, access to childcare services, and housing. Societies might have different strategies for helping young people become economically independent and form stable partnerships, such as providing them with access to high-quality jobs and/or generous welfare state benefits. But it might be the case that once individuals in high-income countries have transitioned to living independently and have formed a partnership, the most important obstacles to childbearing they face have already disappeared.

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"Catching up with 'compressed modernity"' - How the values of Millennials and Gen-Z'ers could reframe gender equity and demographic systems

Stuart Gietel-Basten[1,*]

The brief in this series is to consider this question: "What is the most important factor likely to influence future fertility trends and why?" When we look around the world, there are issues that are more dominant in one place than in another. Moreover, given the broad diversity in the policy mechanisms, labour market contexts, geographies, and cultures of our global(ised) society, it is impossible to identify any kind of catch-all "thing" that will affect fertility rates (if we implement it), as the brief asks us to do.

However, there is one thread that runs through the context of childbearing in all parts of the world: gender equality and equity (or the lack thereof).

Japan and Uganda have, on the surface, little in common. But in each setting, there is a notable gap between the number of children women say they want to have and the number of children they end up having; and gender roles are arguably central to understanding the gaps in each of these contexts. It has been pointed out that Japan represents an extreme example of the "incomplete gender revolution" observed in many lower fertility settings around the world, which implies that changes in women's roles in the private sphere have not caught up to the revolution in women's roles in the public sphere. Moreover, the current #KuToo movement in Japan, in which women are rebelling against the strict dress codes imposed upon them, is just one piece of evidence that the public sphere revolution is hugely incomplete as well. Meanwhile, in Uganda – as in other places around the world – the reproductive aspirations of younger women are all too often frustrated by those with conflicting aspirations and expectations about families or contraception. Sometimes, the individuals who stand in the way are the women's (prospective) husbands.

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Other times, older members of the community or of other organisations, such as the church, attempt to frustrate the reproductive aspirations of (younger) women and men (Kabagenyi et al. 2014; Nalwadda et al. 2010). Consider this quote from an unmarried Ugandan male in his early twenties:

> Parents and elders are against contraceptives. If they find you with a condom, they lose confidence in you . . . parents should be made to accept that things are changing to allow these methods . . . nature is nature, young people need sex, it is better to tell them about contraceptives
>
> (Kabagenyi et al. 2014).

To a certain degree, the gendered inequalities discussed in the Japanese context are also the product of intergenerational transmission. Whether from bosses to workers, or from parents/in-laws to their offspring and their families, there is a multiplier of age and time that accompanies the nurturing and development of gendered norms and expectations concerning work, the family, and all other aspects of life. To return to the #KuToo movement in Japan, the issue isn't just that men are imposing sexist norms on women; but that *older men* (with more power) are imposing sexist norms on *younger women*.

The above quote from Uganda gives us a clue as to the possible resolution of these inequities. Chang Kyung-Sup refers to "compressed modernity" as the "civilizational condition in which economic, political, social and/or cultural changes occur in an extremely condensed manner in respect to both time and space" (Chang 2010, 444). Under these circumstances, "the dynamic coexistence of mutually disparate historical and social elements leads to the construction and reconstruction of a highly complex and fluid social system" (Chang 2010, 444). Perhaps no other society better encapsulates the notion of compressed modernity than South Korea, the home nation of Chang Kyung-Sup. Within two generations, that country has seen a dramatic transformation in almost every aspect of social and economic life. However, certain aspects of Korean society persist, especially around gender; and they operate through the cultural and institutional grip that older generations have on the young. When we look at Uganda, the idea of "compressed modernity" might appear harder to discern. Economic transformation and urbanisation has certainly altered the relationship between the people and the land. However, if we define compressed modernity in the manner above, we can easily imagine modern family planning technology as a "change" that occurred in an "extremely condensed manner"; which has led to the emergence of the kind of "mutually disparate" systems described in the quote above. By extension, the intergenerationally transmitted "dominant yet detached" role of the man in reproductive decision-making (Paz Soldan 2004; Greene 2000) has been shown to be malleable in many parts of the world.

Surveys tend to suggest that younger people are adopting a more gender-egalitarian approach to both work and family than their parents and grandparents, even in parts of the world characterised by very traditional gender roles (Gietel-Basten 2019). Younger people (generally) have more progressive views regarding

family forms, sexuality, family planning technology, birth planning, and female autonomy in reproductive decision-making. A recent study of 12th-graders in the US over the past 40 years found that "contemporary young people exhibited greater openness to a variety of division of labor scenarios for their future selves as parents" (Dernberger and Pepin 2020, 36).

The question, I believe, is whether younger people today will reflect on their (gendered) frustrations under conditions of compressed modernity, and "free" the next generation from these obligations when they go on to become bosses, parents, and, in some cases, religious and secular leaders.

Will they even go further, and draw up a new reproductive contract based on *equity*? If they do, the biggest hurdle to the actualisation of reproductive preferences will be removed, and this shift could, in turn, have a dramatic impact on fertility rates in the future.

In theory, as older generations (and perspectives) are replaced, we might assume that the views of the younger generation automatically become ascendant. Of course, nothing could be further from the truth. As contexts change, so do values. The transition from being a person who wants to buy a home to a person who owns a home may, for example, be accompanied by a profound shift in the person's view of affordable housing. To be sure, the forces of hundreds of years of cultural norms will be exerting substantial pressure to hold such gender roles constant. It may well be the case that the progressive views of the young become so bent and misshapen by the choices they will have to make in order to "conform" to society that these views become unrecognisable by the time they reach middle age. Flexibility around roles is not the same thing as equality or equity in their distribution. Even though the study by Derberger and Pepin cited above found that younger people have greater "openness" to more progressive scenarios of the division of domestic labour, they also observed that "the husband-as-earner/wife-as-homemaker arrangement remained most desired" (p. 36). It appears that there is still a very long way to go.

Thus, it is clear that such a radical change will require a profound shift in attitudes; i.e., a paradigm shift. It will require the sharing of power, rather than the hoarding of it. It will demand a generosity of spirit that is not always easy to muster. "I was bullied, so I will bully you" can translate into "I didn't have kids to further my career, so if you have kids, what do you expect?" In the household, partnerships will have to take on a much more holistic and comprehensive meaning; a fairer, more balanced, more equitable distribution of household responsibilities is urgently needed (Freeman et al. 2018).

So my succinct answer to the question of what factor will have the biggest impact on fertility rates in the future is that it is whether Millennials and Generation Z'ers turn out differently than we and our own parents did, and shape the economic and social system in better, fairer ways. These younger people could start off by updating the reproductive contract for the 21st century by putting gender equity at the heart of it. I really, really hope that they do – and I think they might.

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Future fertility trends are shaped at the intersection of gender and social stratification

Trude Lappegård[1,*]

In this contribution, I argue that future fertility trends will depend on how fertility behavior develops at the intersection of gender and social stratification. Three trends in fertility behavior point to the interaction of gender and stratification. First, men's and women's fertility trajectories differ across the life course, and more men than women remain childless. Although an increasing number of fertility studies have focused on men, there is still far less research on male than female fertility. A recent study from the Nordic countries based on high-quality register data has shown that levels of childlessness are higher among men than among women, with the overall gender difference in ultimate childlessness remaining relatively stable at around 6–10 percentage points across cohorts (Jalovaara et al. 2019). Higher levels of childlessness among women typically predict lower overall levels of fertility (Sobotka 2017). At this point, there is no clear answer to the question of why more men than women stay childless, or of how a gender gap in fertility trajectories will influence future fertility trends.

Second, over the last decade, an unexpected reversal of fertility trends is emerging in the Nordic countries. From 2010 to 2019, the total fertility rate declined from 1.90 to 1.35 in Finland and from 1.96 to 1.53 in Norway. During the 1990s and 2000s, the Nordic countries were viewed as "best practice" societies with relatively high fertility levels and high levels of female employment. As forerunners in implementing work-life balance policies designed to make female employment and family care more compatible, these countries were able to maintain fertility at near-replacement levels. Third, new social inequalities in fertility have emerged. The social gradient of female fertility in the Nordic countries has changed rapidly in recent years, turning into a pattern that increasingly resembles the male pattern of social inequality in fertility behavior. Levels of childlessness are now highest among low educated women as well as among low educated men (Jalovaara et al. 2019). As this new pattern first emerged in cohorts in which a significant proportion still had low education, it cannot simply be considered a selectivity effect. There is, for

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example, new evidence for Australia that fertility has declined more among low educated than highly educated women in recent years, even though low educated women continue to have higher fertility than highly educated women (McDonald and Moyle 2019).

To date, demographic theory has not provided an adequate explanation for the aforementioned trends at the intersection of gender and social stratification. Mason (1997) distinguished two gender systems: one that generates gender (in)equality at the macro level, and another that generates gender (in)equality at the micro level. At the macro level, gender inequality is measured in terms of economic, social, and political opportunities and outcomes; while at the micro level, gender inequality is defined in terms of the gender division of labor within households; i.e., time spent on paid and unpaid work (Mills 2010). From this distinction, two questions emerge: how do people in different social strata respond to gender equality at the societal level; and, how do they act on new gender roles? In particular, the surprising fall in fertility levels observed during the last decade in the Nordic countries – which are characterized by high levels of gender equality and highly developed policies aimed at enabling work-life reconciliation – raises crucial questions about the true nature of the relationship between gender equality and fertility.

Defining gender dynamics as fundamental to fertility, Goldscheider et al. (2015) attributed low fertility levels to the gender revolution that has been occurring in modern societies. They argued that a gender revolution is comprised of two stages. In the first stage, women enter the public sphere; i.e., the labor market and the political arena. In the second stage, which tends to lag behind changes in women's behavior, men take on more responsibilities in the private sphere; i.e., the family. So far, no country has completed either of the two stages of the gender revolution, whereby men and women participate equally in either the public or the private sphere. However, some countries are at relatively advanced stages in these transitions. The two components of the gender revolution are indeed related. While women's employment encourages men to become more involved in the home, it is a weak relationship, as the pace at which men have become more involved at home has not been as rapid as the speed at which women's employment has increased (Frejka et al. 2018).

Low fertility is seen as a response to the gender gap in the workload that can appear when women increase their labor force participation. This trend is expected to reverse and fertility levels are expected to increase somewhat when men become more involved in the home, and the gender workload gap diminishes (Goldscheider et al. 2015; Esping-Andersen and Billari 2015). A forerunner to these theoretical arguments, gender equity theory, predicts that societies with institutional arrangements that facilitate combining work and family life, and that have higher levels of gender equality across public and private institutions, will have higher fertility (McDonald 2000, 2006). Key evidence for the gender revolution prediction that greater gender equality leads to higher fertility is the turnaround in the macro-level relationship between female labor market participation and fertility, whereby countries with the highest levels of female employment have the highest fertility

levels (e.g., Luci-Greulich and Thévenon 2013; Sobotka et al. 2011). As the gender revolution is still ongoing, we do not know the full consequences of changing gender roles within the public or the private sphere. However, the sharp decline in fertility levels in the Nordic countries has called into question the positive association between gender equality and fertility at both the macro and the micro level. Gender equality must be considered in the context of a changing economy, globalization, and increasing economic uncertainty. Thus, to fully explain the new fertility trends, gender equality must be linked to systems of social stratification.

In response to the ongoing gender revolution and the formation of new gender roles, the transition to adulthood may emerge quite differently in different social strata. As we noted above, in the past, childlessness was associated with social stratification in such a way that childless men dominated at the bottom of the social hierarchy, whereas childless women dominated at the top of the social hierarchy (Andersson et al. 2009; Lappegård et al. 2011). These patterns were thought to arise from gender inequality: i.e., when men are the main economic providers, those at the bottom of the hierarchy are not considered as attractive as potential fathers; whereas when women have successful careers, they face higher opportunity costs of having children than other women (Becker 1991). However, these interpretations are based on fertility patterns that no longer hold among the younger generations, especially in the Nordic countries. Moreover, they are based on assumptions about gender inequality in the domestic division of labor and employment rates.

Although it has been heavily debated, the question of whether gender equality plays a positive role in supporting higher fertility has yet to be resolved. To understand how gender equality affects fertility in the face of economic change, we first need to examine how different socioeconomic groups respond to different institutional contexts, and whether these groups benefit from social policies in the same ways. To date, most gender theories have assumed that gender equality tends to equalize differences in fertility across social groups. For example, gender equity theory predicts that higher levels of gender equity will result in fertility levels becoming more similar across social strata (McDonald 2013). As new social inequalities in fertility are emerging, the following question arises: namely, whether highly educated middle-class families following the dual breadwinner model might be better off in the Nordic policy context than members of other socioeconomic groups. Low educated women may face higher opportunity costs of having children than highly educated women; costs that are not alleviated through social policies (Jalovaara et al. 2019). Although highly educated women suffer the largest absolute earnings losses when having a child (Evertsson 2016; England et al. 2016), their income might still be (more than) sufficient to maintain their standard of living. The comparatively small earnings losses low educated women experience when they have a child might nonetheless make it difficult for them to make ends meet (Jalovaara et al. 2019).

Another question that arises in this context is how the gender revolution has changed the partnership formation process for different socioeconomic groups. The new gender imbalance in education – whereby larger proportions of women than

men are now acquiring higher education – is not compatible with the traditional pattern of union formation (in which women tend to "marry up" by choosing a male partner whose educational attainment is higher than their own). On the one hand, this imbalance may create a new kind of "mating squeeze" that could have consequences for union formation and mate selection (Van Bavel 2012). Thus, it is possible that an increasing number of individuals – especially lower educated men and higher educated women – may end up being unable to find a suitable partner (Van Bavel 2012). On the other hand, this imbalance may create new pathways into union formation. For example, it appears that highly educated women are increasingly forming relationships with less educated men (Chudnovskaya and Kashyap 2019). Cherlin (2016) has argued that as the gender revolution continues, both men and women are increasingly searching for a partner with both good earning potential and egalitarian attitudes. Given these trends, finding a partner and establishing a long-term relationship is likely to be especially difficult for both men and women with low education. If this is the case, rising levels of gender equality may generate fewer opportunities for union formation and childbearing among both low educated men and low educated women. Finally, we can look at how different groups at the intersection of gender and social stratification respond to globalization and changing economic conditions. Compared with their highly educated counterparts, young adults with low education face additional obstacles when trying to become a stable earner, as they are more likely to be negatively affected by increasing globalization and the automation of production in a labor market in which temporary contracts and irregular work are becoming more and more common (Mills and Blossfeld 2013). Given the new gender roles that are emerging, increasing economic uncertainty and structural changes in the labor market may mean that both low educated men and low educated women have fewer labor market opportunities than they did in the past, and that they are altering their fertility behavior accordingly.

For these reasons, I have argued that future fertility trends depend on how fertility behavior develops at the intersection of gender and social stratification. This view is based on trends in fertility behavior, such as the gender gap in fertility trajectories, the surprising and strong reversal of fertility trends in the Nordic countries, and the appearance of new social inequalities in fertility. My prediction for future fertility trends is that social stratification will play a larger role than gender in the decision to have children. Because both men and women with low education and poor job prospects will face the most constraints, they will be more inclined than their better educated, higher income counterparts to postpone parenthood and to have fewer children. It is likely that in many countries, these trends will result in lower overall fertility levels. Future research on these new fertility trends should link the two systems of gender equality and social stratification, and investigate how the interactions between them operate depending on the institutional context, changes in the economy, and globalization.

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The wish for a child

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1 'Turn off the lamp'

We quarrel over trivial things, as families do. When I come home from the office, in a country where the sun sets before four in the afternoon wintertime, I like to turn on all the lamps, a behaviour the rest of the household deeply disapproves of. That particular February day in 2020, my 14-year-old daughter switched off a dimmed light exclaiming: "If you continue doing that, I can never have any children!"

I snapped back something about her own carbon footprint, and compared the impact of teenage online series binge watching to me enjoying one modest LED lamp. Internally, however, I was stunned, and quietly pleased. While I knew that my daughter would probably like to become a mother, I had not understood that children were such an integral part of her plans for the future. I also sensed a certain optimism in her calculus: even if energy consumption and our current way of life have created a world in which her generation may not feel safe to have children, the situation could, from her point of view, still be changed – the lamp could be switched off.

My guess is that such a combination of personal wishes and societal hopes will determine future fertility trends in wealthy, democratic societies like contemporary Finland. Individualistic lifestyles, high living standards and perceived resource scarcity – whether economic, social or psychological – have resulted in young Finns currently both wanting to have and actually having fewer children than previous generations. More worryingly, these conditions also appear to have resulted in growing uncertainty and ambivalence regarding the decision about whether and when to have children. In the wake of the novel coronavirus pandemic, levels of economic hardship will be significant, which could further suppress fertility. However, cognitive and emotional resilience might also grow.

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2 To have or not to have

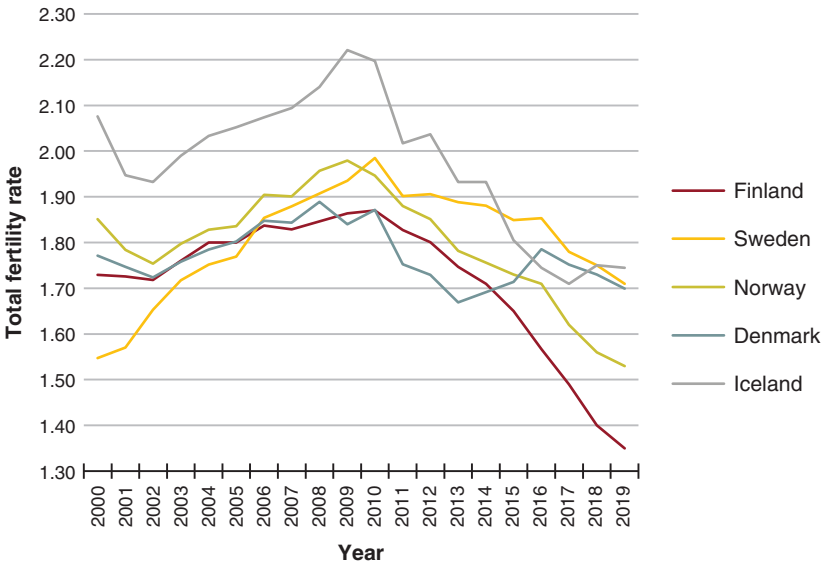
The single key variable influencing fertility in affluent and liberal democracies is the wish to have children. To have or to not have children is the question for many. Individuals who do not want to reproduce can safely and without social stigma avoid doing so. In Finland, as in the rest of the Nordic countries, gender equality has increased in tandem with growing respect for sexual and reproductive rights, efficient sexual education in schools and access to safe and reliable contraceptives. Thus, fortunately, family planning works in the sense of enabling people to avoid unwanted pregnancies. In Finland, most pregnancies are planned and most children are born wanted. Globally, we hold the record for the lowest number of induced abortions (7.6 per 1,000 women of reproductive age in 2019, OSF 2019).

The other side of family planning – whether to have a child, and if so, with whom, and when – may, however, have become trickier, at least for some demographic groups. Making decisions about reproduction has always been a complex process. Sexual desire and parental bonding are species-typical human characteristics that appear in all known societies and in most individuals in conducive circumstances, without being specifically taught or mandated. Yet even these relatively straightforward, biological stepping stones of family formation can vary substantially depending on ecological and cultural conditions and individual characteristics (Hrdy 1999). This is probably because humans have relatively few offspring in which we invest heavily. Throughout our evolutionary history, reproducing at the wrong time could threaten the survival of the mother, the baby and other household members as well. Timing reproduction is, therefore, an important skill, which can be expected to be sensitive to environmental cues about when it is safe and desirable to have a baby (Rotkirch 2007; McAllister et al. 2016).

Today, modern contraceptive use has introduced another cognitive threshold to reproductive decision-making. For most adults in today's Nordic countries, the transition to pregnancy and parenting includes the conscious decision to stop using contraceptives, which has, in turn, become culturally linked to being "ready". This notion generally means having an apartment, a stable income, and a good couple relationship; as well as being individually mature enough and ready to provide the child with time, attention, and good living conditions (Bernhardt and Bergnerh 2013; Rotkirch et al. 2017).

Young adults need to balance the pros and cons of parenting, and are now continuing to do so at higher ages than was the case for earlier generations. Most young Finns move out of their parental home around the age of 24 (Ghosh et al. 2019), and often live alone in adulthood for prolonged periods of time, without a spouse or children. The proportion of Finns aged 20 to 35 years who are living alone has doubled in the last three decades (from 14.2% in 1992 to 28.6% in 2019, OSF 2020b). Thus, there is more time spent living without a family, more space for wishing and planning, and also more room for changing one's mind.

Figure 1:
Total fertility rates in the Nordic countries 2000–2019



Source: National statistical agencies (2020).

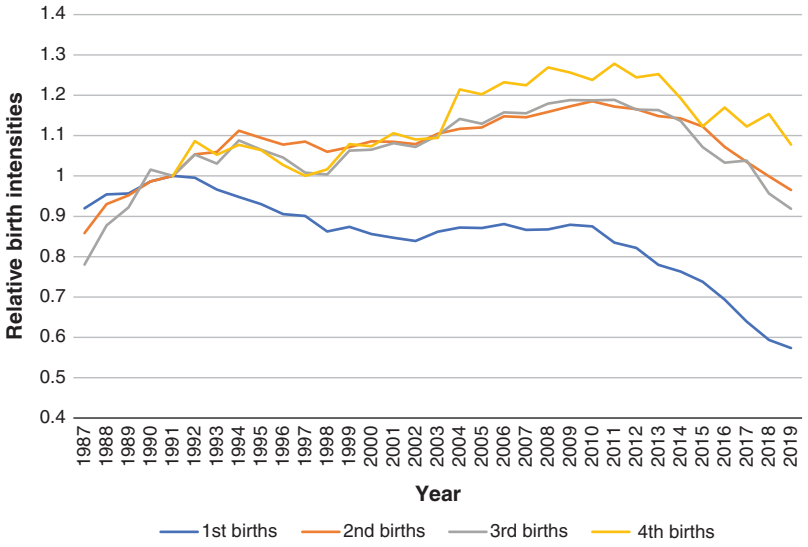
3 Falling fertility in the Nordic countries

Throughout the 2010s, total fertility rates fell in all five Nordic countries, and most dramatically in Finland. As Figure 1 illustrates, Finnish fertility had fallen to 1.35 in 2019. This rate represents an all-time low in a country that has one of the longest annual demographic time series in the world, starting in 1722 (when Finland was a part of Sweden; Reiter and Lutz 2019); it is the lowest level ever recorded in any Nordic country.

Finland is known for its increase in total fertility rates during the country's economic recession in the 1990s, providing an exception to the usual correlation between economic hardship and fertility decline in wealthy countries. However, first children were less likely to be born in the 1990s, and the increase in fertility was driven by higher parities (Vikat 2002). By comparison, the last decade saw a decline in all parities. First births in particular were much less common towards the end of the 2010s than during the preceding three decades, while higher parities have declined to levels comparable to those before the financial crisis of the 1990s (Figure 2).

Indeed, around three-quarters of the decline in fertility in the 2010s can be attributed to women having fewer first children (Hellstrand, Nisén and Myrskylä 2020; Roustaei et al. 2019). This trend may be partly explained by the postponement

Figure 2:
Birth intensity for 1st to 4th children in Finland 1987–2019, 1991=1



Source: Statistics Finland and Population Research Institute.

of the first birth until higher ages. However, throughout the decade, fertility fell in all age groups between 25 and 40, which indicates a pattern of suppression rather than of postponement (Hellstrand, Nisén and Myrskylä 2020). Moreover, as such a prolonged decline in births among women aged 30 and above has not been previously observed in the Nordic countries, it appears to signal some changes that go deeper than postponement.

Period fertility rates can be expected to fluctuate in low-fertility societies (Sobotka 2017), the 2010s may have left a lasting mark on Finnish population dynamics, although it is obviously too early to tell. Given the prolonged decline, the projected completed cohort fertility for women born in Finland in 1975–1988 is also very low, at below 1.6 (Hellstrand et al. 2020). In addition, the scenarios of trends in total fertility rates until 2040 developed by the same research group predict only a slight recuperation, to 1.54 on average (with 95% confidence interval of 1.42–1.67) (Nisén et al. 2020).

The freefall in Finnish fertility came to an end in late 2019, as in the first half of 2020, almost 600 more babies were born than in the previous year (OSF 2020a). However, these early prospects for a modest recuperation in fertility rates may be hampered by the Covid-19 pandemic.

The recent fertility downturn has perplexed demographers and policy-makers alike. For decades, countries with very low fertility had looked to the Nordic

countries for inspiration on issues of early childhood care, parental leave and the participation of fathers. Social scientists at the Population Research Institute, where I work, were used to lecturing Japanese, South Korean, Estonian and Russian visiting delegations about how to achieve both high female labour force participation rates and comparatively high fertility rates. No longer. As a perceptive essay in the New York Times pondered, "Something is stopping us from creating the families we claim to want. But what? . . . Around the world, economic, social and environmental conditions function as a diffuse, barely perceptible contraceptive. And yes, it is even happening in Denmark" (Sussmann 2019). And, it turns out, it is happening in Finland and Norway as well.

4 Lower ideal numbers of children

The Family Barometer surveys conducted by the Population Research Institute have highlighted changes in fertility ideals and intentions, and have documented a clear shift in attitudes towards children over the last decade (Miettinen 2015; Rotkirch et al. 2017). The changed "landscape" of Millennials' childbearing behaviour has been characterised by both the rapid spread of the child-free lifestyle and a higher threshold for entering parenthood for those who want to have children.

First, Finns want to have fewer children now than they did in the past. In surveys conducted in the 1990s and the early 2000s, Finns expressed a desire to have between 2.3 and 2.5 children on average, with quite a few respondents indicating they wanted to have three or more children, and relatively few respondents reporting that they were voluntarily childless: at that time, around 4–5% of the adult population of reproductive age said their ideal number of children was zero, and around 35–40% said they wanted to have three or more children. But by the 2010s, the ideal number of children cited by survey respondents had declined, ranging between 2.0 and 2.2, on average. The share of respondents who were voluntarily childless had risen to around 12% (Miettinen 2015). Among Finns aged 20–29 years, the ideal mean number of children progressively declined from 2.54 in 2008, to 2.32 in 2015 and to 2.27 in 2018 (Berg 2018; Berg et al. n.d.).

As the road from formulating an ideal number of children to becoming a parent is uneven, people in most developed societies have fewer children than they want (see, e.g., Stone 2019 and the Fertility Ideals Database). In Western societies, few individuals who do not want to have children of their own end up having them (e.g., Gemmill 2019), but many of those who want to have children do not end up having as many as they had hoped for. It is easier to remain childless than it is to become a parent. From this perspective, the clear reduction in childbearing ideals among Finns goes a long way towards explaining the downturn in total fertility rates. If a larger proportion of young adults today — representing up to a threefold increase over previous generations — prefer to have no children, they will succeed in remaining childless. Among the rest, the desired numbers of children are somewhat lower, and the numbers of children they will actually have will continue to be below those

levels (e.g., if you want three, you may end up with two; and if you want two, you may end up with one or zero).

Second, the threshold to becoming a parent appears to be higher now than it was in the past. Parenthood is perceived as being a highly demanding responsibility that requires considerable personal, material and social resources. This is a desirable development from the child's point of view, since having dedicated and resource-providing parents boosts a child's well-being and development. But for parents, the standards they are expected to meet are high: namely, that both partners have a foothold in the labour market, have a proper home, feel emotionally ready, and are certain that they want to become parents. As a consequence of these pressures, people with more resources also reproduce more: while fertility rates have fallen across educational groups, they are currently lower among men and women with lower education than with higher education (OSF 2017). Thus, it appears that those who "have it all" will also have more children (see also Mencarini et al. 2018).

5 Uncertainty and lifestyle factors

While the forces that are transforming childbearing cultures are not fully understood, it is clear that the standard economic or policy factors do not suffice to explain them (e.g., Comolli et al. 2019). Social and economic factors have not grown objectively worse in the lives of young Finns; indeed, they have mostly improved. Family policies and leave benefits remain generous, and levels of gender equality have increased, both in Finnish society and within households.

Several explanations have been proposed for the Finnish fertility decline of the 2010s, ranging from the country's historically high levels of childlessness (Rotkirch and Miettinen 2017) and of individualism, which may be helping to create a "low fertility trap" (Lutz et al. 2006), to the effects of the 1990 recession on the Finnish economy (Rotkirch et al. 2017).

One explanation for lower fertility that seems quite plausible is related to perceived uncertainty and stalled social mobility (e.g., Comolli 2017). Another is related to lifestyles: i.e., that as social media raises people's awareness of global lifestyles to an unprecedented extent, certain standards of travelling, living and consuming appear desirable, and also within reach for increasingly large proportions of the population.

In a factor analysis of declared reasons for postponing or foregoing childbearing provided in the *Family Barometer* survey from 2018, two main factors emerged, which we refer to here as uncertainty and lifestyle. Among Finns aged 20–49, *uncertainty* was shown to be related to the "traditional" factors that represent economic constraints. For example, respondents expressed concerns that they had an unsatisfactory financial or work situation, that they or their partner were still in education, that they were receiving insufficient support from society, or that their current apartment was too small. The uncertainty the respondents reported was also related to social resource scarcity, such as having difficulties arranging childcare,

combining work and childcare, or advancing in their profession or career; as well as to psychological doubts about having a child, such as concerns that they were too young or not mature enough, or that their relationship was not strong enough. The other main factor found to be associated with not having children, *lifestyle*, was more clear-cut, with significant shares of respondents expressing a reluctance to give up their current lifestyle. Specifically, many young adults said that they did not want to be tied to children, that their lifestyle was not suitable for parenting, or that having children was not an issue in their relationship (Savelieva et al. n.d.).

Unfortunately, the *Family Barometer* surveys did not ask young adults about their attitudes towards climate change. Qualitative evidence indicates that such considerations feature in reasons relating to both perceived uncertainty and lifestyle: i.e., that being worried about climate change is not the decisive reason to forgo reproduction, but it is yet another argument against having children. Notice, for instance, how anxiety over climate change intertwines with job and social uncertainty in this account written by a young married man in his late twenties in the autumn of 2019[1]:

> [B]oth of us have baby fever, but our life situation is too unstable. We are both working, but my partner lacks a steady job … we lack social support since we live far away from our relatives … and of course we are also worried about what kind of future would await our children.

"Of course, we are also worried": this general sense of malaise about the way the world is going may serve to dampen enthusiasm for becoming a parent. Among other Finns surveyed, concerns expressed about immigrants and their impact on the country served the same rhetorical purpose.

In the same collection of comments regarding fertility, a 36-year-old, voluntarily childfree woman related procreation to overpopulation, and asked more provocatively:

> Why would I sacrifice my couple relationship, my body, my sleep and my money in order to have one more mouth to feed in this overpopulated world?

Interestingly, having fewer babies in very low-fertility countries is not an ecological adjustment that has been recommended by international bodies or initiatives for directly tackling climate change. Nevertheless, this argument featured prominently in the green and left-leaning public discourse, and in parts of the mainstream media in the 2010s in Finland. For instance, one Facebook post said, "I can now fly to Thailand with better conscience, because I am childfree", thereby implying that having a child and having an exotic holiday are equivalent variables in the

[1] This and other quotations were collected by the large evening newspaper Iltalehti in autumn 2019 in connection with a story about falling fertility. The non-representative survey received 432 open responses, which are available upon request from the author.

individual's carbon footprint calculation (I quote freely from memory). By contrast, very few voices in the 2010s in Finland discussed eco-parenting as a sensible way to promote climate-friendly living. Even fewer voices pointed out that raising children also contributes to the economy and to society as a whole.

It is in this culturally quite peculiar context that my own daughter's more optimistic outlook – solve the crisis, so I can have children – sounded encouraging to me.

Have ideals declined similarly elsewhere? Perplexingly, questions about fertility ideals are not regularly asked in international comparative surveys, and comparable data from Nordic countries are lacking. We will have to wait for the next wave of the Generations and Gender Surveys to find out.

6 Gift or sacrifice

Previously, I used to strictly separate the lifestyle and the scarcity answers when trying to grasp why fertility was declining in my home country. Voluntary childlessness is a personal decision and a human right, I stressed, while also emphasising that people's experiences of anxiety, scarcity and uncertainty can and should be addressed with policies.

However, while these positions on childbearing might call for different policy responses, is it possible that they are fuelled by the same underlying cultural and economic forces? Maybe they both reflect a situation in which having children is simply not very trendy, and parenting has lost some of the allure it once had as a path to maturity and self-fulfilment. In some earlier cultures, having a child was perceived as a resource and a sign of strength, and therefore as a stepping stone to adulthood. The Human Resource Database includes a description of an African tribe in which a young woman would always carry a child when she went to visit the neighbouring village. If she did not have a baby of her own at the moment she could borrow somebody else's child for this purpose. In some societies, having a child was the norm for young women, almost like dressing up with the right handbag is currently part of normative femininity. Recently, a Finnish career woman told me that she does not wear her new wedding ring to work because she does not want her boss and colleagues think she could be on the pathway to motherhood.

In this cultural setting, the visibility and attraction of parenting may have weakened among young adults. Moreover, the interdependency and vulnerability at the core of the parent-child relationship can seem overwhelming, both for those who feel uncertain about parenting and for those who do not want children ("Will I be good enough?").

A study from Sweden noted that for childless adults, children are perceived as representing the "non-modern" parts of life – i.e., as burdensome, demanding and not fitting the ideal lifestyle. "The child connotes dependence and responsibilities in a society where independence and self-actualization are highly valued, and may thus be referred to as non-modern" (Bernhardt and Bergnerh 2013, p. 102). The authors

added that most people value parenthood, but strive to postpone having children in order to enjoy "the unrestricted freedom of single life for quite some time". In focus group interviews conducted for the Family Barometer in 2017, we noted exactly the same attitude among young Finns (Rotkirch et al. 2017).

At a more structural level, we could also say that, the current version of global capitalism is inimical to procreation. As a New York Times article formulated it:

> Our workweeks are longer and our wages lower, leaving us less time and money to meet, court and fall in love. Our increasingly winner-take-all economies require that children get intensive parenting and costly educations, creating rising anxiety around what sort of life a would-be parent might provide. A lifetime of messaging directs us toward other pursuits instead: education, work, travel (Sussmann 2019).

The force of other pursuits and rising anxiety noted in that article are echoed in this comment by a 34-year-old Finnish woman, who said that she has had a hard time finding a committed partner, but also pondered whether she would have time for a family:

> My work requires me to be constantly available and I am responsible for keeping the shop open – even if that means dropping everything … If I don't have time at the moment for my friends and my own parents, how would it be with a family and children?

Crucially, the alternative to parenthood – never to have children – appears to have become more thinkable among young adults today than it was among previous generations. This may be that case for both those who cite uncertainty and those who mention lifestyle choices as their reasons for postponing or foregoing childbearing. A telling sign is the use of the word "sacrifice" as a metaphor for becoming a parent, as in the comment by the Finnish woman above. Having a child can be seen as a sacrifice, while remaining childless is associated with having access to the positive aspects of life (sleep, sex, career). In many cultures, the metaphor of sacrifice would have been used for those who forgo parenthood.

It is as if many childless adults are saying: "If I do not get a stable job, or better pay, or more social support, then I'm better off childless". Such a decision is certainly not for anybody to judge, but it is also an extremely difficult decision to make, as people who choose childlessness cannot know what they are giving up. Furthermore, assessing any opportunity costs in a situation of stress is demanding. Psychological studies have illustrated that experiencing stress and a lack of resources can greatly lower people's capacity to solve problems and think through different solutions, causing them instead to shift to a "tunnel focus" on the perceived threat (e.g., Shafir 2017). While moving to a tunnel focus can help individuals tackle the threat or the challenge at hand, it may increase the risk of overlooking other alternatives.

It would be interesting to know the extent to which people take the opportunity costs between having or foregoing childbearing into account – assuming they are

emotionally capable of doing so. It would also be valuable to study how perceptions of parenthood – i.e., as a burden or a sacrifice, or as a gift and a blessing – have changed over the decades, and to what extent adults think through different options, or avoid making decisions and "sleepwalk into infertility" (Daniluk 2015). What we do know is that the vast majority of parents see having children as extremely rewarding and meaningful, and that these dimensions and experiences are currently not easily transmitted from those who are living with young children to childless young adults.

7 From uncertainty to resilience?

The economic and existential uncertainty accompanying the Covid-19 pandemic is likely to further depress fertility levels in wealthy countries. At the same time, intense and global crises can change perspectives. In an early and funny essay on the impact of the pandemic published in The Guardian, Stephen Marche commented that even before the lockdown, "[T]he standard position of my life has been the one I find myself in right now – everyone I know isolated and suddenly broke". Marche linked the isolation and social fragility of his generation to what he described as a dire need for more solidarity and interconnectedness:

> At moments, Covid-19 feels like no more than an allegory for the condition of my generation: we have been inside, behind screens, while a global catastrophe unfolds, since our 20s (Marche 2020).

It is, of course, easy and fully justified to predict that economic hardship will make family formation challenging. But what about the desire to have children, or the value of close family and kin in one's life? As societal collapse unfolds, values may also shift, at least temporarily. Being reduced to one's innermost circle may highlight the importance of having such a circle in the first place. The presence of death can also help to draw kin closer together, and boost fertility (see, e.g., Berg et al. 2020). There are already reports that levels of religiosity are higher as a consequence of the pandemic (Gecewicz 2020), and religiosity is, in turn, one of the best-known value predictors for higher fertility (Philipov and Berghammer 2007). In 2020, there have certainly been fewer opportunities to enjoy the "unrestricted freedoms of single life".

To the extent that the decline to very low fertility levels in some countries reflects a "crisis of intimacy", the social fabric in some communities may change for the better after the experiences of global solidarity and altruism in 2020. Interdependency and vulnerability may become more widely accepted. I hope that such a shift can provide room for views on families, households and the raising of children to become more relaxed, more cooperative and more community-based – which could, in turn, raise levels of both demographic and social resilience in Europe. Childbearing decisions in wealthy and liberal societies have become squeezed by the pincer grip of raised

expectations and growing uncertainty. So what happens if this world stops, and then restarts?

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Fertility will be determined by the changing ideal family size and the empowerment to reach these targets

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1 Introduction

The long-term fertility trends in different parts of the world will matter greatly for sustainable development and future human well-being on this planet. Progress in the global demographic transition and the resulting changes in the sizes and structures of human populations have been shown to be key drivers of modern economic growth through several mechanisms. Unified Growth Theory (Galor 2011) clearly demonstrates how the increase in human capital associated with the shift from the quantity to the quality of children has been driving economic development. This has also been shown by the extensive literature on the demographic dividend (Bloom and Williamson 1998; Lutz et al. 2019). But the future paths of fertility and the resulting population growth have also been identified as important factors in efforts to deal with climate change and other environmental risks (Bongaarts and O'Neill 2018). The effect of fertility on economic growth and environmental change may be even more important than the challenges posed by population growth in providing people with the ability to live a life of dignity and freedom from poverty, as stipulated by the Sustainable Development Goals (SDGs). It is clearly harder to meet all of these goals while leaving no one behind – one of the key SDG principles – if the world population continues to grow rapidly. Among the Shared Socioeconomic Pathways (SSP), the Stalled Development Scenario (SSP3) projects that the global population will grow to around 14 billion people by the end of the century, while the Rapid Development Scenario (SSP1) projects a corresponding figure of just seven billion (Lutz et al. 2018). This difference by a factor of two,

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which is mostly due to different fertility assumptions, will have serious implications for future human well-being.

Where future population growth will come to lie between these two rather extreme scenarios will essentially depend on two factors: the speed of fertility decline in Africa and the long-term fertility level at the end of demographic transition. In this contribution to the demographic debate, I will argue that for both factors, changes in the ideal family size – which I will use here synonymously with the desired family size – are the key drivers. Moreover, I will show that these changes primarily happen in our minds, and are only secondarily influenced by changing economic realities and environmental factors. Another reason why I prefer to use the notion of the ideal family size is that it is directly linked to the notion of developmental idealism, which has been discussed extensively with respect to family norms by Arland Thornton (2005). This approach is based on the premise that our actions are a consequence of our norms, and of what we consider as good and desirable in our minds. But before we can realize these desires, we need to be empowered to do so. This empowerment has several dimensions, which go from women being able to convince their partners – and, in some societies, their extended family and peers as well – to allow them to pursue their family size desires, to having access to acceptable means of contraception and reproductive health services (including medically assisted reproduction). As I will argue below, for many of the dimensions of this process of reproductive empowerment, female education is a decisive factor.

2 The future of Africa's fertility

Much has been written about the drivers of fertility decline in Africa, and I will not attempt to summarize this literature here. I only aim to selectively highlight a few recent insights into this complex topic. In the 2010 issue of the *Vienna Yearbook of Population Research* on the topic of education and demography, John Bongaarts published a paper entitled "The causes of educational differences in fertility in Sub-Saharan Africa" (Bongaarts 2010), in which he clearly showed that the main reason for the high fertility in Africa is that the desired family size is large. More educated women have both a smaller desired family size and fewer unwanted births. Hence, education has a dual effect on lowering fertility: i.e., it reduces the ideal family size, presumably through changes in values and in the associated quantity/quality considerations; and it empowers women to actually realize this smaller family size by averting unwanted births.

This pattern of explanation has recently been confirmed by two highly comprehensive studies (Kebede 2019; Kebede et al. 2019) that pooled all the individual-level data from all African countries and for all years that are available from the DHS (Demographic and Health Survey), which enabled the authors to study more than 1.8 million births to more than 500,000 women. One interesting finding from a multi-level study of differentials in the ideal family size (Kebede 2019) was that at each level (individual, community, and country) the effect of education was stronger

than that of income, and that the effect of education was particularly strong at the community level. This implies that even less educated women who were living in a village with more educated women had smaller ideal family sizes, presumably due to processes of normative diffusion and social learning (Kebede 2019). A cohort-specific analysis of fertility showed that the much-discussed stalling of the fertility decline around 2000 in some African countries can be largely explained by an earlier stalling of improvements in education – possibly in association with the structural adjustment programs of the 1980s – among the female cohorts who entered their prime childbearing ages around 2000 (Kebede et al. 2019). Here again it was apparent that more educated women wanted to have fewer children, and were finding better ways to actually have fewer children. And given that the education of girls has picked up again in many African countries since 2000, a rather rapid decline in fertility over the coming years seems likely.

3 Fertility levels at the end of demographic transition

In Africa and in some countries in Western Asia where fertility is still rather high, the factors that will lead to fertility decline are relatively clear, and the only open question is the exact timing of this decline. By contrast, the main drivers of and the long-term trends in fertility are much more uncertain in populations that have reached the end of the demographic transition. Here we are groping in the dark, and only feel confident in saying that the long-held view that all countries will ultimately converge to the so-called replacement level of 2.1 is untenable, and without a scientific basis. This perspective appears to reflect some sort of belief in homeostasis that assumes that there is an inherent tendency of populations to reach a state of equilibrium in which they neither grow nor decline. This view has also been reinforced by the ubiquity of the United Nations population projections. For decades, these projections had assumed that life expectancy would stabilize at a certain level, which had to be shifted upward repeatedly as reality surpassed previous estimates; and that fertility in all countries would converge to the replacement level, and thus reach a point of permanent stability after a period of some turmoil caused by the demographic regime changes associated with the demographic transition. This view was also politically convenient for the United Nations, because it told governments that conditions would stabilize: i.e., that their populations would neither explode nor shrink and ultimately disappear. Unfortunately, reality has turned out to be different, as today an increasing number of governments – mostly in Eastern Europe – are deeply concerned about depopulation, not only due to low fertility, but to out-migration.

In global population projections, the long-term fertility target has now been lowered from 2.1 to somewhere between 1.75 and 1.85 (United Nations 2019; Lutz et al. 2014). However, there is no convincing scientific rationale for these estimates. Hence, one may ask why such long-term projections are even produced. The problem is that long-term population projections are needed for many purposes –

e.g., the study of climate change and the human populations affected in different parts of the world – and that in making such projections, one must assume some TFRs over the long term, even if the scientific basis for doing so is very tenuous. Gietel-Basten et al. (2013) have presented some sensitivity analyses of the very long-term implications of different ultimate fertility levels. In the scenarios that assume a maximum life expectancy at birth of 100 years, and that the stated fertility levels will be reached in all parts of the world by 2050, a long-term TFR of 1.75 would result in a world population of 8.5 billion in 2100, 5.6 billion in 2200, and 3.2 billion in 2300. If the TFRs converge to 2.0 by 2050, the long-term population size would be in the 10-11 billion range over the coming centuries. If, however, the TFRs converge to 1.5 – which is around the current European average – the world population would, after peaking at 8.6 billion, decline to 6.9 billion by 2100, and further decline to 2.7 billion in 2200 and 0.9 billion in 2300. In other words, the current European levels, which are still higher than the levels currently observed in East Asia, would, in the very long run, bring the world population down to below one billion – that is, to the level that humanity experienced throughout its entire history up until around 1800.

These purely hypothetical scenario calculations show that minor differences in fertility levels can have massive consequences for long-term population size. And my point here is that the question of whether a TFR is 1.50 rather than 1.75 or 2.00 will primarily depend on the ideal that is in people's minds as to what number of children is associated with living a successful and happy life.

4 Revisiting the low fertility trap hypothesis (LFTH)

In 2006, Lutz, Skirbekk, and Testa published a paper in the *Vienna Yearbook of Population Research* that was entitled "The low fertility trap hypothesis: Forces that may lead to further postponement and fewer births in Europe" (Lutz et al. 2006). The underlying concept was based on the following hierarchy for fertility and births. First, personal ideal family size is assumed to be the fundamental driver of fertility, which is then transformed into a specific family size target when conflicting interests and constraints are taken into account. In a next step, these fertility targets are translated into period fertility rates that are sensitive to choices around the timing of births. Finally, period fertility rates are translated into certain absolute numbers of births in a given calendar year for which the changing age structure of the population is also taken into consideration. At each of these steps, external influences come into play that partly represent feedbacks from earlier fertility levels, as is evident in the case of the age structure of the population and the number of young people entering reproductive ages. But the key hypothesis of LFTH is that the most basic underlying determinant – namely, personal ideal family size – is in part determined by how young people have been socialized, and by what they see as the new norms pursued by other people around them. These experiences shape young people's own norms about family size. This can also be seen as feedback from earlier declines in fertility that resulted in smaller actual family sizes, and which, in turn, influenced

the family size norms of the next generation. This mechanism by itself could result in a downward spiral of ever-lower fertility and ever-smaller actual family sizes, even if no other factors come into play.

In 2008 in a paper discussing LFTH in Europe and East Asia, I asked the question: "Has Korea's fertility reached the bottom?" (Lutz 2008). At that time, the TFR in South Korea was 1.25, and few people believed it could fall any lower. In 2018 and 2019, the Korean TFR has actually fallen below 1.0. While this very low period fertility level is likely due in part to tempo effects that are a consequence of the postponement of births, to what extent fertility in South Korea will recover over the coming years is not at all clear. Following the LFTH framework, this very low level could also be due to changes in either the ideal family size, important competing aspirations and conflicts that result in lower target fertility, or a combination of the two. There is not yet enough empirical evidence to disentangle these different determinants of fertility in East Asia. But in the urban areas of China, there is some evidence that after many years of living under the one-child policy, and in a situation in which most couples actually have only one child, the one-child family has become the new norm, with a large majority of couples saying that they want to have only one child, even though they are now allowed to have two (Basten and Jiang 2015).

In Europe, by contrast, the two-child norm still seems to be dominant, at least until recently (Sobotka and Beaujouan 2014). Over the last decade, a rather unexpected decline in fertility rates has been observed in several European countries, including in the Nordic countries. This pattern in the Nordic countries is particularly puzzling given that these countries used to be seen as the prime examples for the premise that ensuring the compatibility of work and family and having generous child support systems will result in relatively high fertility levels. In Norway, for example, the TFR has declined from 1.96 in 2008 to 1.56 in 2018. In Finland, the TFR has declined from 1.85 to 1.40 over the same period, without any clearly identifiable social, economic, or family policy changes having occurred. Demography is still groping in the dark for explanations for these changes. It appears, however, that there may well have been some ongoing cultural changes in these societies that have affected the relative importance of children, and, as a consequence, the ideal family size.

5 Empowered to better reach one's ideal family size

In an earlier Demographic Debate in the 2017 *Vienna Yearbook* on education and fertility in low-fertility settings, I gave my contribution the title: "Education empowers women to reach their personal fertility target, regardless of what that target is" (Lutz 2017). In this paper, I also explained some of the mechanisms through which the cognitive learning experiences associated with education tend to strengthen abstraction skills, lengthen the planning horizon, and even improve self-control. These benefits are in addition to the more widely recognized effects of education, which include having better access to information and the ability to

earn a higher income. These are all key aspects of the empowerment of women, which, among many other good things, improve their chances of realizing whatever their family size ideals are. I have discussed this contribution of female education to fertility decline in Africa above. But this empowerment effect is also present in many low-fertility countries. It can help explain why in some countries a U-shape emerges in the relationship between education and fertility. Assume for the time being that the ideal family size is two children for all women, irrespective of education. In such a scenario, women with low education will tend to have relatively high levels of fertility, because there is still a degree of fatalism in their reproductive behavior, and higher proportions of their births are likely to be unplanned. On the other extreme, women with high education will tend to be able to plan their life more effectively, even if they often have to deal with difficult trade-offs between advancing their career and establishing a family. But they will also tend to have higher levels of human and social capital that will enable them to better combine work and family life, and, therefore, to come closer to their ideal of having two children than women with intermediate income levels, who are likely to struggle more to make ends meet, and to combine work and family life in a satisfactory manner. Thus, this latter group of women are likely to have somewhat lower fertility. Hence, these differences in the empowerment of women can help to explain the emerging U-shape in several countries.

I still believe that this narrative is plausible and probably right. But in that case, why don't we observe a U-shape with respect to education in all low-fertility countries? The reason is that not all women in a given country have the same ideal family size, and they are even less likely to have identical family size targets. Empirically observed fertility differentials tend to result from a mixture of the ideal family size and empowerment effects. While I still believe that the empowerment effect is universal in all cultures and at different levels of the fertility transition, the ideal family size can differ considerably. For example, highly educated orthodox Jewish women in Israel often want very large families, and manage to have very large families. But in other countries, large proportions of highly educated women have evidently accepted that having children is not compatible with having a career, and manage these trade-offs by staying childless. Thus, in the long run, culturally and socially determined family size desires may result in very different fertility levels.

Is there something in our genes that will ensure that a certain minimal level of fertility is maintained? From a purely biological perspective, the sex drive seems to be the main mechanism that evolution produced for ensuring that there will be sufficient reproduction. This is also reflected in Robert Malthus' famous statement that fertility is unlikely to decline because "the passion between the sexes will never diminish" (Malthus 1798). But thanks to contraception, fertility around the world has declined without the passion having diminished. Reproduction has now mostly entered the realm of conscious choice (Coale 1973). And where will this conscious choice lead us? I got the clearest answer to all of these crucial questions from the leading evolutionary biologist Simon Levin of Princeton. In response to

my question of whether human evolution will ensure a certain minimum level of reproduction, his short answer was: "Once reproduction is culturally determined, cultural evolution can bring you almost anywhere." And the key mechanism through which culture works in this context is via the shaping of the ideal family size as the fundamental determinant of future fertility.

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Marriage will (continue to) be the key to the future of fertility in Japan and East Asia

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1 Introduction

Determinants of fertility differ across countries, and, to some extent, across regions with shared social, economic, political, and cultural backgrounds. Therefore, I would like to refine the theme, "What is likely to be the most important factor influencing future fertility trends?", by limiting my geographical focus to Japan, the country I am mainly studying. But my research on Japan is also relevant to other East Asian societies that have similar cultural backgrounds and fertility trends shaped by similar socioeconomic developments:[2] namely, South Korea, Taiwan, and, to some extent, mainland China. These countries share, to varying degrees, family norms influenced by the tradition of Confucianism and its emphasis on patriarchal parent-child relationships, gender-based role specialization, and hierarchal relationships based on seniority (Cheng 2020). The region also includes countries/regions with some of the world's lowest fertility rates: Taiwan (TFR: 0.90 in 2010), South Korea (TFR: 0.98 in 2018), and Japan (TFR: 1.25 in 2005). I would like to use this opportunity to share some thoughts on why fertility is so low in East Asia by (primarily) examining Japanese data; and to discuss what I see as being the most important determinant of future fertility trends in Japan and other East Asian countries.

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[2] For a detailed overview of fertility and family patterns across East Asia, see Frejka et al. (2010) and Raymo et al. (2015).

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2 Marriage as a primary predictor of fertility in Japan (and East Asia)

In my view, the most important factor influencing fertility trends in Japan – and most likely in other East Asian countries as well – has been and continues to be marriage. In the following, I will elaborate on this view by providing some empirical evidence.

First, it is clear that marriage is essentially the only type of union in which couples have children in Japan and in East Asia. The proportion of births outside of marriage in Japan was only 2.2% in 2017, up from 0.8% in 1980 (Ministry of Health, Labor and Welfare (hereafter, MHLW) 2018). Similarly, in South Korea, the proportion of births outside of marriage increased from 1.1% in 1981 to just 1.9% in 2017 (Korean Statistical Information Service 2019). The very high share of marital births in East Asia makes singlehood a strong proxy for childlessness. At the same time, the timing of marriage strongly influences completed levels of marital fertility in Japan. The female mean age at first marriage has been increasing continuously since the early 1970s, rising from 24.2 in 1970 to 29.4 in 2014, and levelling off thereafter. As a result of this trend, the completed fertility of married women in Japan – which is measured as the average number of children born to women in a first marriage who have been married for 15–19 years – was stable from 1982–2002 (1982: 2.23, 2002: 2.23), but has declined slightly since then, and had fallen to 1.94 by 2015 (National Institute of Population and Social Security Research (hereafter, NIPSSR) 2017a).

The extremely low prevalence of extramarital childbearing in Japan can be seen as a cultural norm (Hertog and Iwasawa 2011), but it can also be explained from a legal point of view. A large share of the growth in non-marital childbearing in Western societies is attributable to increased childbearing within consensual unions; thus, the prevalence of non-marital childbearing is at least partly related to the legal status of non-marital consensual unions (Perelli-Harris and Sánchez Gassen 2012). Although scholarly attention to this issue has been lacking, common-law marriage in Japan is a legally defined consensual union that is comparable to non-marital unions in Western countries. Couples in common-law marriages intend to live as spouses, even though their relationship is not legally registered as married. The prevalence of common-law marriage relationships in Japan is not fully known, as the civil registration of such unions is not required, and these couples are often recorded as "married" in censuses or in other representative social/demographic surveys. In Japan, common-law marriage is similar in form to legal marriage. For example, the couples in these relationships share a residence and have legal obligations to provide mutual economic support and sexual exclusivity. Couples in common-law marriages in Japan are also entitled to the same social security benefits as married couples,

such as national health insurance, pension, and other public assistance benefits.[3] However, the marital benefits in the taxation system do not apply to couples in common-law marriages. When dissolving their relationship, the partners in a common-law marriage are also entitled to the same legal rights as married couples, such as the right to divide their mutual assets or to claim compensation if the other partner is responsible for the dissolution. But, in general, union dissolution is easier in common-law marriage than in legal marriage in Japan because the dissolution of a common-law marriage does not require the use of formal administrative procedures to deregister the marriage in the family register system.

However, legal marriage and common-law marriage differ significantly in terms of the legal protections and legal rights they confer, not only with respect to the relationship, but to the couple's children. First, whereas the right of inheritance from a deceased partner is based on agreements made by the couple in a common-law marriage, the partners in a married couple are automatically entitled to inherit from one another. Second, and most importantly, when a child is born within a common-law marriage, the child is registered as "illegitimate," and the custody of the child is awarded exclusively to the mother. By contrast, when a child is born to married parents, the mother and the father automatically share custody. Furthermore, a newborn child of parents in a common-law marriage needs to be recognized by the biological father in order to receive obligatory support from him. Without this recognition, the child would not even have a right to inherit from the biological father. In addition to these differences, the existence of a common-law marriage relationship is often difficult to prove because there is no official record of this relationship, particularly if both parties contribute to the social security system separately. Moreover, the distinction between common-law marriage and unmarried cohabitation is rather fuzzy, as it is based solely on whether the partners "consider" their relationship to be an alternative to legal marriage. Therefore, claiming the legal rights associated with common-law marriage is not straightforward, especially when the partners are in conflict with each other. Thus, under current civil law in Japan, there is little incentive for couples, and for women in particular, to have a child outside of legal marriage.

3 Is there any change in the marriage-fertility nexus?

As I discussed above, marriage is currently the only broadly accepted setting for childbearing among Japanese couples, and there is little indication that non-marital

[3] To claim these benefits, the partners need to inform their workplaces (or, to be more precise, their colleagues who are in charge of employee social benefits) that they are in a common-law marriage, because employers in Japan are legally obliged to manage the collection and provision of social security contributions/benefits among their employees. However, given the low prevalence of common-law marriage in Japan, couples in such unions are often reluctant to declare their relationship to their workplaces, as it may be considered socially deviant, and represent a risk to their reputations.

childbearing is becoming more common in Japan, or is likely to do so in the future. However, this does not necessarily mean that marriage will continue to be an important factor in future fertility in Japan. In fact, there are slight but important signs of changes in the pathways to marriage and fertility within marriage. In this section, I will describe these new trends, and examine whether they signal the emergence of some broader changes in the marriage-fertility nexus.

3.1 Cohabitation

The very low percentage of births outside of marriage implies that the options for forming an alternative union are limited for couples looking to start a family in East Asia. Surveys show that only 1.7% (2015) of young adults aged 18–34 in Japan are currently living in a non-marital union (excluding common-law marriage) (NIPSSR 2017a). The proportions of young adults who have ever experienced cohabitation are, not surprisingly, somewhat higher. For example, the proportion of never-married men and women aged 25–29 in Japan who have ever had a cohabiting relationship increased from 4% in 1987 to 10% in 2005, and then levelled off until 2015. However, the same survey also shows that the proportion of married women who had cohabited with their current spouse before marriage increased from 10% of the women marrying in 1990–1994 to 33% of the women marrying in 2005–2010 (own calculation from the 14th Japanese National Fertility Survey (hereafter, JNFS)). These figures suggest that cohabitation in Japan is becoming increasingly common among women who marry. In addition, the large gap in the prevalence of cohabitation experience between the married and the never-married population clearly suggests that cohabitation in Japan serves as a prelude, rather than an alternative, to marriage. Currently, however, this increasing trend in premarital cohabitation is unlikely to alter the rigid order of marriage and childbearing in Japan.

3.2 Premarital pregnancy

Pregnancy has long served as a strong motivation for unmarried couples in Japan to marry. The share of first births resulting from premarital pregnancies (adjusted by the mother's age) increased from 18% in 1995 to 28% in 2002, and levelled off thereafter (MHLW 2010). The proportion of first births resulting from premarital pregnancies is also larger among younger than older mothers (82% at age 15–19, 64% at age 20–24, 25% at age 25–29, 12% at age 30–34, and 10% at age 35+ in 2009) (MHLW 2010). It is important to keep in mind that the close linkage between marriage and childbirth in Japan (and, likely, in other East Asian countries) is partially due to the tendency to "legitimate" premarital pregnancies. Thus, marriage cannot be seen entirely as a "determinant" of fertility. It is also very likely that marriage rates have declined in part because young men and especially young women do not feel ready to enter parenthood, with all the expectations, duties,

and obligations it entails (Tsuya and Mason 1995). In other words, the causal link between marriage and fertility runs both ways. In this sense, the role of marriage as a "determinant" of fertility is not independent, but is, rather, highly intertwined with fertility decisions. However, it should also be noted that most women in Japan are projected to marry by age 50 (82% in the 1990 birth cohort) (NIPSSR 2017b). Assuming that levels of non-marital childbearing continue to be low, the reversed causation or inter-related process of marriage and fertility pertains to the first birth only. Therefore, the timing and prevalence of marriage would still be the most powerful proximate determinant of fertility in Japan, particularly for second- and higher-order births.

3.3 Decline in marital fertility and increase in marital instability

The view that marriage is an important proximate determinant of fertility rests in part on the assumption that marital fertility is stable over time. However, the strong two-child norm reported by the cohorts of Japanese women who married before the 1980s has since been fading. A tendency to delay the first birth after marriage is becoming increasingly apparent among women who have married since the 1990s, even after controlling for the age at marriage (Fukuda 2007). Substantial delays in the transition to parenthood among married women are expected to result in increasing numbers of married women ending up having only one child (NIPSSR 2017b). The trend in marital fertility is, therefore, likely to be more important in determining future levels of fertility.

Another important trend influencing marital fertility is the declining stability of marriages in Japan. For instance, the divorce rates per 1,000 married women age 30–34 increased from 2.2 in 1960 to 14.4 in 2010, and then declined slightly to reach 13.6 in 2015 (NIPSSR 2019). Based on the period divorce rates around 2000, around one-third of Japanese marriages are estimated to end in divorce (Raymo et al. 2004). Remarriage rates per 1,000 divorced or widowed women aged 35–39 show a similar trajectory, increasing from 14.2 in 1960 to 60.0 in 2010, and then declining to 54.6 in 2015 (NIPSSR 2019). Due to the general increase in divorce and remarriage rates, the share of new marriages that were second or later marriages for at least one of the spouses increased from 15% in 1980 to 27% in 2015 (MHLW 2018). Although previous studies on marital fertility in Japan have focused entirely on the fertility of first-married couples, the prevalence of divorce and its consequences for remarriage and fertility have become critical factors to consider when evaluating the potential impact of marriage and marital fertility on future fertility trends.

My review generally confirms that while marriage continues to play a major role as a proximate determinant of fertility in Japan, there have been some important changes in pathways to marriage, levels of marital fertility, and the stability of marriage. The extent to which marriage can be seen as a proximate determinant of fertility in Japan depends on how these trends develop in the future.

One of the challenges policy-makers seeking to increase East Asian fertility face is the expansion of the unmarried and non-partnered population. Indeed, Japanese data show that growing shares of young adults are not even in a dating relationship: among never-married survey respondents aged 18–34, 70% of men and 59% of women indicated that they had no dating relationships in 2015 (NIPSSR 2017a). Studies have suggested that the prevalence of work-related stress and the decline in the economic standing of young adults are partially responsible for this trend (Genda and Saito 2007; Nakamura and Sato 2010). However, other factors that may contribute to the decline in dating relationships among young people are not well understood. While most policy efforts to increase fertility focus on promoting childbirth among married couples, it is very difficult to directly promote marriage or even dating among young adults via public policies.

4 What is the most important factor influencing future marriage trends?

Assuming that marriage continues to play a major role in determining fertility trends in Japan and East Asia, what is the most important factor influencing marriage trends?

A large body of research has examined the relationship between education and first marriage in East Asia. Education appears to be one of the most important factors influencing marriage rates. Participating in education provides young people with opportunities to meet potential partners. Educational attainment serves as a proxy for longer-term earnings potential and economic stability (Blossfeld and Timm 2003), and determines the timing of marriage. Indeed, the expansion of male and female tertiary education and the decline in first marriage are among the most prominent social changes in East Asia.

One of the consistent findings regarding East Asian marriage trends is a negative educational gradient in female marriage, which is thought to reflect gender role specialization based on the male breadwinner/female homemaker model of marriage (Blossfeld and Timm 2003). However, recent studies have shown a weakening or even a reversal of this relationship in Korea (Park and Lee 2017), Hong Kong (Zhou et al. 2017), Taiwan (Cheng 2014), and Japan (Fukuda et al. 2019). My recent study with colleagues illustrated that during the 1990–2015 period, the negative educational gradient in female marriage in Japan first disappeared around 2005, and then turned positive after 2009 (Fukuda et al. 2019). This shift in the educational gradient was brought about by a combination of a decline in the marriage rates of less educated women and an increase in the marriage rates of highly educated women. The former finding is consistent with expectations derived from theories on globalization and labor market bifurcation (e.g., the concentration of non-standard employment in less educated groups); whereas the latter finding is consistent with predictions stemming from the gender revolution framework, including the

expectation that highly educated women have a more advantaged position on the marriage market (Fukuda et al. 2019). These patterns of change are generally consistent with trends documented in the U.S. and in many other wealthy countries. It should be noted that the ideational shift toward dual-earner marriage – which is likely to be facilitated by both economic uncertainty and the preference for more gender-equal sharing of economic roles – will be an important factor influencing marriage trends in Japan, and possibly in other East Asian societies in which highly educated young adults have become a majority in the marriage market. Given these findings, it is likely that policies aimed at supporting female employment and work-family balance will have a positive impact on both marriage and childbearing.

5 Conclusion

In this short article, I provided my thoughts on the factor that is most likely to influence future fertility trends in Japan, while drawing on a wide range of available data. My conclusion is that marriage continues to be the most important proximate determinant of future fertility in Japan, and, arguably, in other East Asian societies as well. Marriage itself is being affected by the trends in female tertiary education and the concurrent shift toward a dual-earner marriage ideology. However, I am aware that future fertility trends may not conform to a simple extrapolation of current fertility behaviors. For instance, young adults' dating behaviors and the pathways to marriage are changing; marriage has become less stable; and marital fertility is declining. These changes may also reshape the link between marriage and fertility trends in the future.

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REVIEW ARTICLE

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Ultra-low fertility in East Asia: Confucianism and its discontents

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Abstract

This study reviews the institutional factors that have influenced the fertility and family trends in five East Asian societies that experienced a precipitous transition to very low fertility: China, Japan, Hong Kong, South Korea and Taiwan. The paper begins by outlining the unique family formation patterns of these societies and the existing explanations for their observed ultra-low fertility levels. In particular, it highlights the role of Confucian culture, which emphasises patriarchal values and credentialism, in shaping the current state of low fertility in East Asia. For example, the ways in which Confucianism affects women's roles at home, the effectiveness of pronatalist policies and the burden of human capital investments among parents are discussed. With these contextual factors and the current very low fertility rates as a backdrop, this study also examines attitudinal changes in marriage and family values that have taken place in these societies after the new millennium. These changes could further erode the traditional family and influence family formation trends in the future. The article concludes by discussing recent policy responses and the possible future of fertility in East Asia.

Keywords: fertility transition; ultra-low fertility; East Asia; Confucianism; patriarchy; credentialism; value changes; pronatalist policies

1 Introduction

> Health Minister Hakuo Yanagisawa, 71, in January publicly described women as 'baby-making machines' and suggested Japan had a birthrate problem because women were failing in their duty to produce children. In November, Hakubun Shimomura, 52, one of Prime Minister Shinzo Abe's top aides, said the country could easily address a national shortage

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> of public daycare if women would simply 'stay at home and raise their children'.
>
> *Washington Post*, March 2007

In East Asia, matrimony and childbearing have been seen for centuries as paramount life events of unquestionable moral significance and status for young adults. However, by 2018, three East Asian advanced economies (i.e. Hong Kong, Taiwan and South Korea) have all experienced period total fertility rates (TFR) below one child per woman, a level that is almost unprecedented in any Western low-fertility society.[1] While tempo effects play a crucial role in causing such low rates, cohort total fertility rates (CTFR) have also declined from at least two children for the early 1950s cohorts to 1.2–1.8 children for those born in 1970. Such dramatic changes have led to concerns being raised and some fingers being pointed in this region, which has long been characterised by patriarchy and misogyny. When very low fertility rates first hit this region after the 1990s, accusations that young people are selfish and materialistic began to emerge. It is not uncommon to hear politicians making comments about how young women are deviating from their traditional childbearing and homemaker roles and duties. Derogatory terms such as "leftover women" and "loser dogs" have also been coined to describe unmarried, childless women above age 30. Indeed, the city mayor of Taipei in Taiwan, Wen-Je Ko, once blamed women for posing national security concerns by not marrying and having children, and only changed his statement to include men after single women and feminist groups expressed irritation (Gerber 2015). Similar comments about a single Korean female professor nominated for a government position also sparked anger in 2019 (McCurry 2019). This kind of scapegoat narrative lies at the heart of the Confucian patriarchal culture that is shared across all East Asian societies (Gietel-Basten 2019).

Meanwhile, East Asia is also a region in which female empowerment through education and employment has progressed tremendously over the past few decades. It has, however, become clear that the relatively rigid patriarchal cultural and family systems of East Asia are maladapted to women's rising status and economic independence. The traditional social order of male and elder dominance at home has become increasingly incompatible with women's professional pursuits and their expectations of an ideal marriage. This mismatch inevitably lowers women's motivations to get married and to bear children, as doing so tends to entail obligations that hinder women's personal aspirations, and that confine them within the domestic realm under the traditional Confucian ideology of ideal wifehood and motherhood. In addition, traditional Confucian values place heavy emphasis on academic attainment, which has its roots in the civil service exam system in ancient China. These ingrained values are reflected in a shared strong valuation of academic

[1] A very low TFR of 0.77 was once observed in eastern Germany (the former GDR) during 1993–94, shortly after the unification of Germany.

pursuits, which translates into the prevailing credentialism found in the region. This increases the costs of raising children and heightens the quality-quantity anxiety among (would-be) parents.

While past research has provided explanations for why fertility rates declined to very low levels so rapidly in East Asia, most of these studies focused on social and structural changes. Very few studies have attempted to look at the overarching cultural ideology that has shaped the unique fertility patterns in East Asia. This paper will begin by offering an overview of the social and demographic profiles of five East Asian societies[2] that experienced precipitous transitions to very low fertility. We will then review the paths to ultra-low fertility levels and the unique features of these societies, followed by the commonly discussed causes that give rise to such phenomena. In particular, this study highlights the role of Confucian culture, which emphasises patriarchal values and credentialism, in shaping the current low rates of family formation in the region; and how it influences women's roles at home, the effectiveness of pro-natalist policies and the burden of human capital investments among parents. With these contextual factors and current very low fertility rates as a backdrop, we also examine attitudinal changes in marriage and family values that have taken place in these societies after the new millennium. These changes could further erode the traditional family and influence family formation trends in the future. The article concludes by discussing recent policy responses and the possible future of fertility in East Asia.

2 The region of East Asia

Slightly more than one-fifth (roughly 1.6 billion) of the world's population live in East Asia, and the region is home to some of the fastest growing economies of the past half century. However, the socio-historical backgrounds of these societies vary. China has been a socialist state since the mid-20th century and underwent economic reforms in the late 1970s. Hong Kong was a colony of the United Kingdom until 1997 and has remained a global financial centre since it was returned to China. While industrialisation started as early as in the late 19th century in Japan, it took off much later in Taiwan and South Korea (abbreviated as Korea hereafter), and did not affect their demographic development until the latter half of the 20th century. These socio-historical factors have created different trajectories of economic development and paces of fertility decline across these societies. For instance, the timing of the emergence of below-replacement fertility across the region ranges from the

[2] The societies included in this study are China, Hong Kong, Japan, South Korea and Taiwan. Mongolia and North Korea will not be discussed, mainly because of their near-replacement-level fertility rates and data availability issues. While Singapore has undergone cultural, economic and demographic developments similar to those of its East Asian neighbors, geographically it is located in Southeast Asia, and will not be discussed here.

Table 1:
Socio-economic and demographic profiles of five East Asian societies

	China	Hong Kong	Japan	South Korea	Taiwan
Population (in millions)	1,400	7.4	127	51.5	23.5
GDP per capita (nominal)[1]	$9,610	$48,520	$39,310	$31,350	$24,970
HDI[2] 2018	0.752	0.933	0.909	0.903	0.907
TFR[3] 2018	1.64[6]	1.07	1.42	0.98	1.06
CTFR (cohort 1970 at age 40)[4]	1.70	1.15	1.43	1.75	1.70
% childless for cohort 1970[5]	n.a.	35%	27%	10%	16%

Note: [1] Based on 2018 IMF data; [2] HDI refers to Human Development Index; [3] TFR refers to the period total fertility rate; [4] data compiled from the Human Fertility Database, Frejka (2017) and Myrskylä et al. (2013); [5] the childlessness statistics come from the Human Fertility Database and the 2018 Hong Kong Monthly Digest of Statistics (Census and Statistics Department 2018); [6] the TFR reported by the National and Local Health and Family Planning Commissions is 1.6 (Leng 2017), but Guo et al. (2019) reported that the TFR is 1.05 based on the 2015 1% micro-census in China.

mid-1950s in Japan to the early 1990s in China. By the latter half of the 2000s, the countries of East Asia were experiencing some of the lowest fertility levels ever recorded in the world (i.e. the TFR reached a low of 0.9 in 2003 in Hong Kong and in 2010 in Taiwan).

The socio-economic and demographic profiles of East Asian societies differ markedly (Table 1). Hong Kong has the smallest population, but the highest income levels and human development score in the region. In contrast, compared to its neighbours, China has the largest population and a higher period total fertility rate (at least according to some sources), but lower income levels and a lower human development score. Taiwan and South Korea have more similar profiles in terms of income levels, period total fertility rates and human development indices, whereas Japan has higher income levels and period fertility rates than these two countries. The gap between the TFR and the cohort fertility rates (CTFR) observed at age 40 for women born in 1970 suggests that in Korea and Taiwan, there have been strong tempo effects as well as declines in fertility quantum due to increased rates of lifelong singlehood. In contrast, the tempo effect in China is less visible, and the narrow difference between the TFR and the CTFR in Hong Kong reflects a convergence of both period and cohort fertility to extreme low levels. In addition, the share of childless women in the 1970 cohort reveals how variations in the levels of completed fertility rates can be attributed to diverging rates of childlessness. The speed of increases in the percentages of childless women has been remarkable: from about 11% to 28% for the cohorts born between the early 1950s and 1970s in Japan; and from about 9% to 16% for those born in the early 1960s and 1970s in Taiwan. These contextual differences set the backdrop against which different trajectories of the fertility transition came into being in contemporary East Asia.

While the remarkable economic growth in the region since the 1970s is often cited as the cause of the rapid decline in fertility to very low levels, the deep-rooted Confucian culture in East Asia is another crucial factor. This cultural system is characterised by a hierarchical and patriarchal social order in which men have dominance over women, the elderly have higher status than the young, and rulers have more power than their subjects. Confucianism not only governs family life, it puts great emphasis on educational credentials earned through the state examination system. It also places a woman (wife) in a subordinate position relative to her husband. These hierarchies were historically facilitated by low levels of education and high levels of illiteracy, and by early marriage for women, which was common well into the 20th century. The remnants of these practices have hampered the progress of gender equality in recent decades. When placed within a collectivist family system, persistent gender inequalities make childbearing and childrearing a heavy burden for young couples in societies with rising living standards and increasingly competitive market economies.[3]

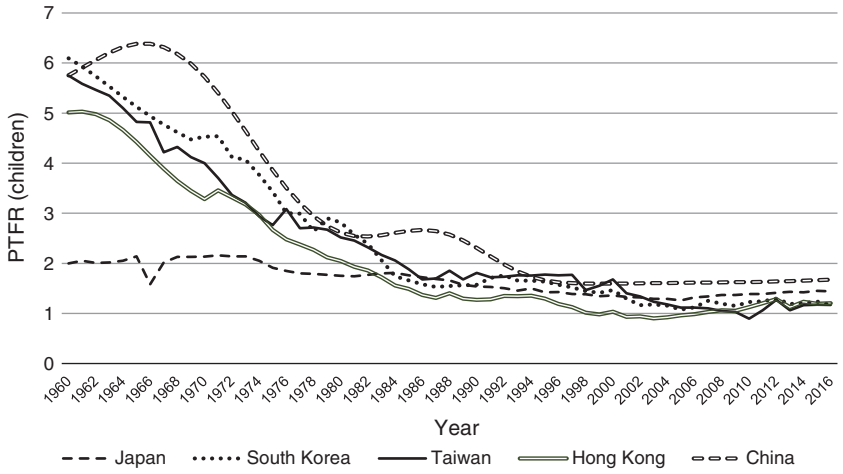
3 East Asian fertility transition

3.1 Rapid fertility decline within four decades

While in the Western developed world, period fertility rates have been at their historically lowest levels since the 1970s, very low fertility did not emerge in East Asia until the 1990s. Unlike the patterns observed in most regions in Europe, in which a fertility reversal often took place after a historical low point was reached, the majority of East Asian societies have reported TFRs below 1.5 for two decades or longer. While the CTFR rarely dropped below 1.5 children in the Western developed countries (except in Southern Europe), the forecasted CTFR for the late 1970s cohorts will likely dip below 1.5 children for Taiwan, Japan and Korea (Myrskylä et al. 2013) and will certainly be below this level in Hong Kong. The speed and the scope of the fertility decline in East Asia are remarkable, particularly given the region's collectivist culture with strong family traditions. By the end of the 2010s, East Asia had become a region with persistent ultra-low fertility that was reporting some world record-breaking period rates: both Hong Kong and Taiwan reached the

[3] Even though Singapore, with a population of 5.6 million, is not included in this paper, it is also a high-income Confucian country with a GDP per capita (nominal) of 64,580 U.S. Dollars and a high HDI of 0.935 in 2018. Low period fertility rates below 1.5 children were first observed for a few years in the late 1980s and again since the late 1990s until today. In 2018, the period TFR was only 1.14 children. The cohort TFR for the early 1960s cohorts is 1.82 and will likely drop just below 1.5 for the early 1970s cohorts (Chuan 2010). Nearly 25% of women aged 40–44 remained childless in the early 2010s (United Nations 2014).

Figure 1:
Period total fertility rates in East Asia, 1960–2016

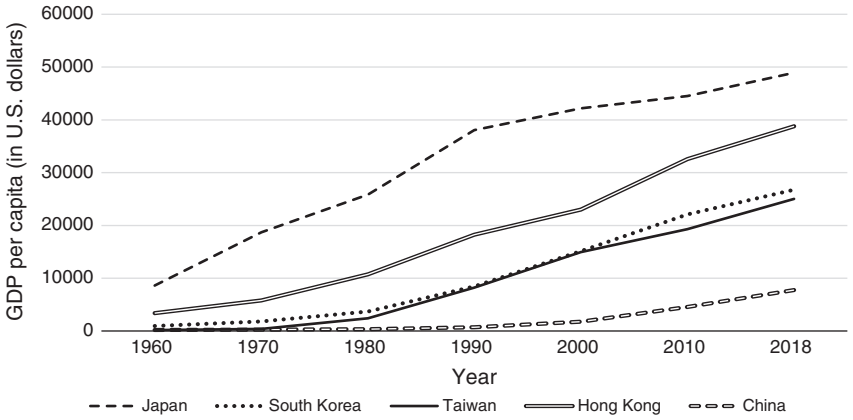


Source: Figures for Japan, South Korea and Hong Kong come from World Bank Database (https://data.worldbank.org/indicator/SP.DYN.TFRT.IN/). Figures for China come from the United Nations 2019 World Population Prospects. Figures for Taiwan come from the Population Statistics Database, Ministry of the Interior, Taiwan (https://www.ris.gov.tw/app/portal/346).

historically low period fertility rate of 0.9 in 2003 and 2010, respectively; and in 2019, South Korea experienced an extremely low period total fertility rate of 0.92.

These five societies have undergone their fertility transitions at different speeds, and their total fertility rates have been substantially suppressed by tempo effects due to delayed childbearing. As Figure 1 shows, Japan experienced the earliest fertility transition from five children per woman in the pre-war era to a below-replacement level in 1957 (Tsuya 2017). The fertility transition happened much later in Hong Kong than in Japan, with Taiwan and South Korea experiencing very similar trajectories (Basten 2015). China was the last country in the region to reach below-replacement fertility, as it did not achieve that level until the early 1990s. During these periods of rapid fertility change, fertility quantum initially declined due to decreasing marital fertility rates. Tempo effects caused by the delayed timing of marriage (and thus, of childbearing) also suppressed period TFR. As the latter effects persisted for some time, parts of the "tempo" impact became permanent "quantum" losses due to rising levels of lifelong singlehood (and thus, of childlessness) in this region. Such patterns have been observed in Taiwan, Japan, Hong Kong, and South Korea (Yoo and Sobotka 2018; Frejka and Ross 2001; Jones 2007; Frejka et al. 2010).

Figure 2:
GDP per capita in five East Asian societies (U.S. dollars at 2010 price)



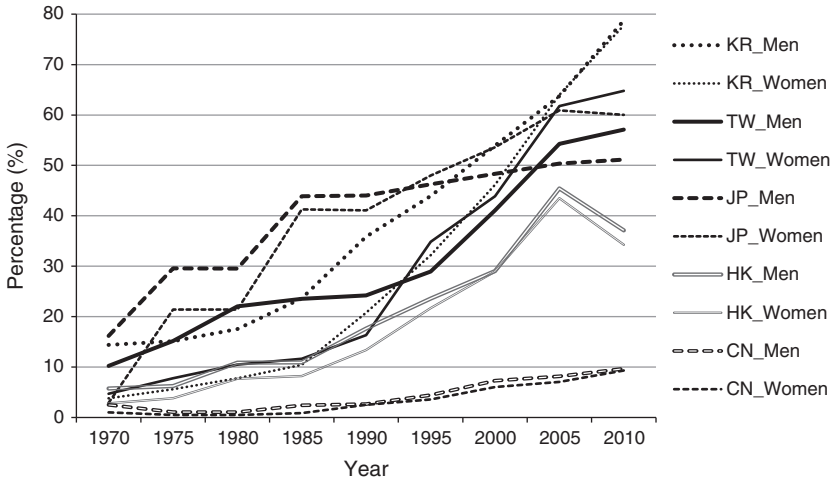
Source: Population Statistics Database of Taiwan (https://eng.stat.gov.tw/point.asp?index=1); World Development Indicators from the World Bank (https://data.worldbank.org/indicator/NY.GDP.PCAP.KD).

These rapid fertility transitions occurred during times of tremendous economic growth and female empowerment in the region. All societies in East Asia experienced impressive growth in GDP per capita during the post-war years, albeit at different paces. Figure 2 shows that Japan, as the earliest industrialised country in the region, achieved the highest GDP throughout the entire observation period, followed by Hong Kong. Taiwan and Korea have experienced very similar trajectories and levels of GDP growth, while China's level of economic development is still much lower than that of its neighbours, even though its growth rates over the past two to three decades have been remarkable.

Economic growth fuelled by industrialisation and subsequent labour demands have prompted governments in most of these societies to expand educational opportunities or to lengthen the duration of compulsory education. Figure 3 presents the trends in the shares of men and women aged 25–29 with tertiary education from 1970 to 2010 in these five societies. Japan began investing heavily in human capital from the 1970s to the 1990s. Thus, Japan was a forerunner in the trend towards investments in higher education in the region, largely due to the Meiji Restoration and its early initiation of industrialisation starting in the late 19th century. The trends in Korea and Taiwan converged to that in Japan in the mid-2000s, with more than half of the population aged 25–29 completing tertiary education in these three countries by 2010. The corresponding share is a bit lower in Hong Kong, at 45%; while China has the lowest share of tertiary education graduates, at less than 10%.

This rapid educational expansion also contributed to more women entering the labour force. The trajectories of female labour force participation (FLFP) patterns

Figure 3:
Percentage of population aged 25–29 with tertiary education

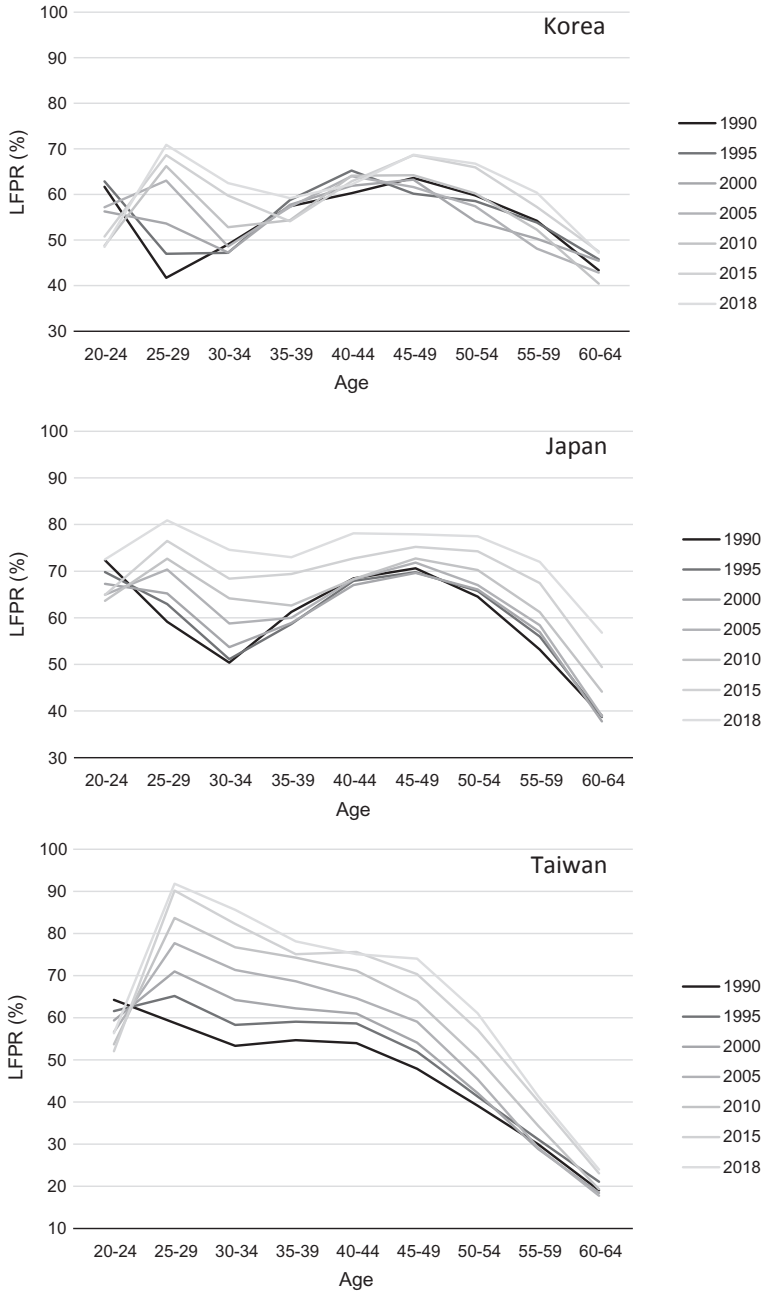


Source: Barro and Lee (2018).

in Japan and Taiwan have exhibited impressive levels of growth across all ages since 1990 (Figure 4). The patterns in Korea are slightly different: there has been a dramatic rise in FLFP among women in their late twenties, but FLFP has stagnated somewhat (or even decreased) for women in their late thirties and early forties. Long-term time series data for FLFP by age are not available for Hong Kong and China, although the existing statistics indicate that female labour force participation rates in Hong Kong increased from 47% in 1990 to 54% in 2018, and the comparable rates for China declined from 73% to 61% over the same period (The Global Economy 2019; International Labor Organization 2019).

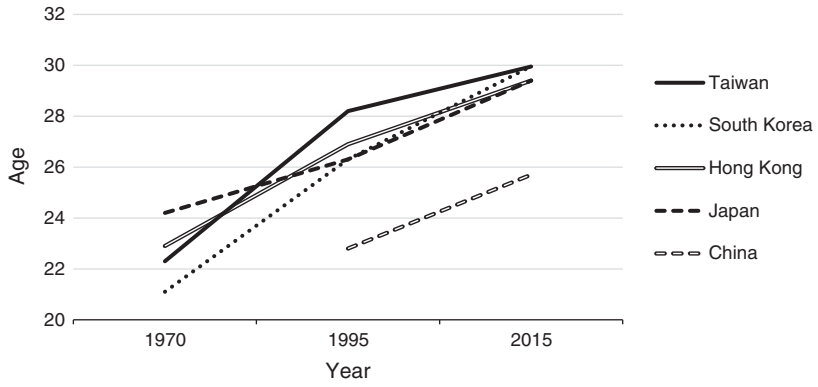
As the years spent in education and levels of labour force participation have risen among women at prime reproductive ages, marriages have increasingly been delayed or even foregone. In all five societies, marriages have been postponed to much later ages since 1970, although the pace of the rise in the mean age at first marriage has been less dramatic in China (Figure 5). Along with delayed matrimony, levels of lifelong singlehood have increased rapidly in all societies in the region except China (Figure 6). Overall, the patterns observed in China up to 2010 indicated that the country still had a relatively early and universal marriage regime. However, delayed marriage and rising levels of singlehood have become more prevalent in China during the last decade. According to the National Bureau of Statistics in China, the number of registered marriages has declined rapidly, from 13 million in 2014 to 10.6 million in 2017; while the mean age at first marriage among women has risen to 25.7 years. Past research also indicates that there are notable

Figure 4:
Female labor force participation rates by age and year since 1990



Source: OECD Statistics Database and National Statistics Database of Taiwan.

Figure 5:
Mean age at first marriage among women in five East Asian societies, 1970–2015



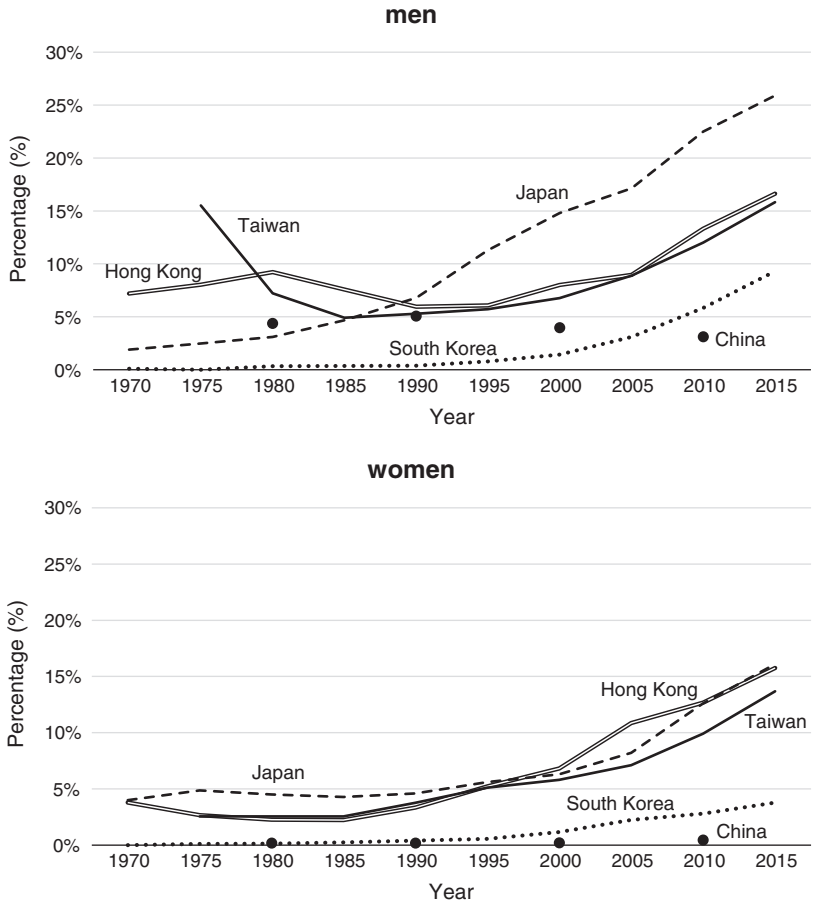
Source: Taiwan: Population Statistics Database (https://www.ris.gov.tw/app/portal/346); South Korea: KOSIS-Korean Statistical Information Services; Japan: e-Stat, Statistics of Japan (https://www.e-stat.go.jp/en/); Hong Kong: Women and Men in Hong Kong - Key Statistics (2019 Edition); China: Lu, Jie-hua and Xiao-fei Wang (2013). Change of the Marital Status in Mainland China since1990s (in Chinese, 20世紀 90 年代以來我國婚姻狀況變化分析). *Social Sciences of Beijing* (北京社會科學). 2013(3): 62–72. Figure for 2015 comes from the National Bureau of Statistics, People's Republic of China.

regional variations in the timing and the prevalence of marriage, with later entry into marriage being observed more frequently in urban areas and in eastern China than in the rest of the country (Ji and Yeung 2014). Hence, even though the marriage patterns in China now seem quite different from the late, non-universal marriage patterns that characterise the other four East Asian societies, they might converge slowly in the years to come. However, a recent report from the New York Times suggested that instead of the Chinese government putting forth more measures to balance work and family, there has been "a resurgence in traditional gender roles that has increasingly pushed women back into the home" (Qin 2019). It remains to be seen whether fertility rates in China decline to even lower levels as increasingly well-educated Chinese women resist the pressure to marry.

3.2 China as a special low-fertility case

As the previous discussions indicate, the transition to below-replacement level fertility in China lacked many of the characteristics of this transition observed in other East Asian low-fertility regimes. These characteristics include a large share of women with tertiary education, a very late mean age at first marriage and a large percentage of women who had never married by age 50. Rather than being similar to those of its East Asian neighbours, the historical marriage patterns in China since 1970 more closely resemble those in Southeast and South Asian countries

Figure 6:
Percentages of never married men and women at age 50



Source: Taiwan: figures taken from the *Statistical Yearbook of Taiwan*, 1975–2015; South Korea: statistics provided by Dr. Yoon-Jeong Shin, using the 2% microdata of Korean Census data since 1970; Japan: figures taken from *Population Census of Japan*, Statistics Bureau, Ministry of Internal Affairs and Communications, Japan; Hong Kong: figures from the Hong Kong Statistics Database, Census and Statistics Department (https://www.censtatd.gov.hk/hkstat/index.jsp) and UN Database (Population by Marital Status, Age, Sex, and Urban/Rural Residence); China: figures taken from UN Database (Population by Marital Status, Age, Sex, and Urban/Rural Residence).

in terms of the mean age at marriage and universal marriage (Yeung et al. 2018). With regard to female empowerment, most low-fertility societies witnessed rising female labour force participation rates along with declining fertility rates, whereas China actually experienced the opposite pattern: FLFP in China decreased from about 90% in the 1960s (due to state socialism) to about 60% in the late 2010s (due to extended schooling), while over the same period, the TFR declined from six

to 1.6 children. The initial stage of rapid fertility decline to sub-replacement levels in China also occurred during a period when the growth in women's educational attainment was limited. In terms of the socio-economic context, the GDP per capita in China is likely one of the lowest among all countries with similar levels of fertility. All in all, fertility decline to below-replacement levels in China took place within a unique set of structural conditions, which differed from the modernisation pathways of fertility decline observed in its East Asian neighbours. That is, prior to the implementation of the one-child policy in 1979, a dramatic decline in fertility from 5.8 to 2.8 children occurred that was largely driven by the strong enforcement of the later-longer-fewer state policy (Cai 2010; Peng 1991) during a time of relatively low economic development (Attané 2002; Peng 1991). While the fertility transition has progressed much faster in urban than in rural areas since the 1960s, some scholars have suggested that economic development played a non-negligible role after the 1980s in further depressing fertility to sub-replacement levels (Poston 2000; Cai 2010; Gietel-Basten and Cheng 2019), even though others have disagreed (Goodkind 2017).

3.3 Uniqueness of East Asian fertility patterns

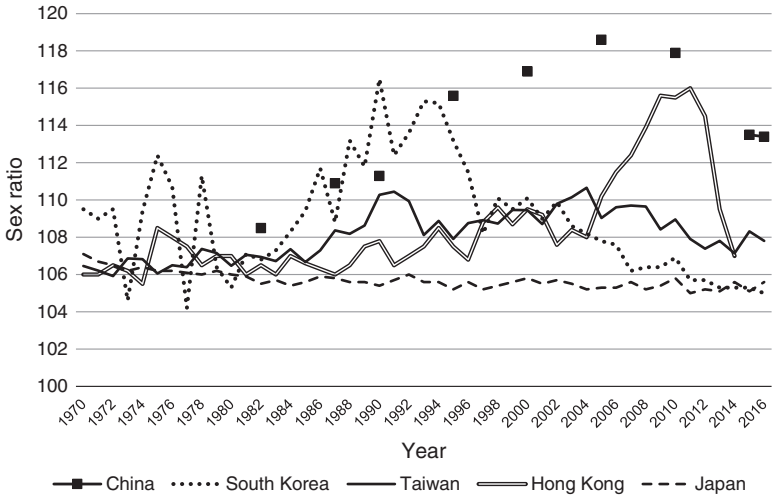
In addition to being characterised by the rapid transition from a high-fertility region during the mid-20th century to a region with ultra-low fertility rates at the turn of the millennium, the fertility patterns in East Asia have a few more unique traits: skewed sex ratios at birth[4], low rates of non-marital birth, rising prevalence of bridal pregnancies and relatively low rates of cohabitation.

3.3.1 Skewed sex ratios at birth (SRB)

High sex ratios at birth largely started emerging in different regions around the globe since the 1980s, when sex-testing techniques became more widely available. Female foetuses are thus selectively aborted in many countries with patrilineal family systems, such as the Caucasus and parts of South Asia (especially India), East Asia and Eastern Europe (Guilmoto 2015). As Figure 7 shows, China (Goodkind 2011), Hong Kong (Basten and Verropoulou 2013) and Korea are three societies in this region with more extreme sex ratios at birth that once exceeded 115, although the SRBs in Korea normalised after 2007 (Choi and Hwang 2020; Den Boer and Hudson 2017). The SRBs have been a bit less distorted in Taiwan, where they rose above 110 for a few years. Japan stands out as the only country in East Asia that has not had imbalanced sex ratios in recent years, even though there

[4] Japan is an exception, although historical evidence has revealed that there was a male surplus in pre-modern times (Caldwell and Caldwell 2005).

Figure 7:
Sex ratios at birth in five East Asian societies since 1970



Source: Department of Household Registration, Taiwan; vital statistics of Japan and South Korea; Hong Kong vital registration data and Chao et al. (2019); UNICEF database (https://www.unicef.cn/en/figure-19-sex-ratio-birth-19822017) for China.

is historical evidence of distortions in Japan, such as of excess male infants due to the prevalence of female infanticide during the Tokugawa period in pre-modern Japan (Caldwell and Caldwell 2005; Drixler 2013). Although the scope of the male surplus at birth may appear slightly less alarming in Taiwan, Hong Kong and Korea than in China, the fact that sex ratios at birth initially rose with the expansion of women's educational and occupational attainment over the past decades has made the situation in these three societies more disturbing than it is in China or India, where women's socio-economic attainment progressed much more slowly than it has in these more advanced East Asian economies. In contrast, Asian societies with a bilateral kinship system (in which descent and inheritance are passed equally through both parents) are much less likely to have skewed sex ratios at birth. This is the case in much of Southeast Asia (Yeung et al. 2018), even though Singapore and Vietnam are two exceptions because of their Confucian heritage.

3.3.2 Low rates of non-marital birth

Contemporary fertility patterns in East Asia are also characterised by a low percentage of births outside of marriage, which is in stark contrast with the patterns observed in many Western developed societies. According to the latest statistics, the

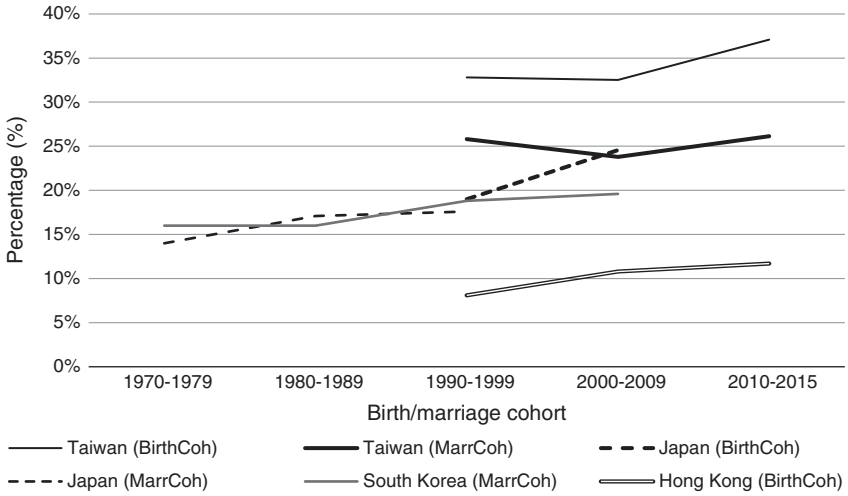
share of non-marital births is about 1.5% in Korea, 2% in Japan and 4% in Taiwan (Raymo et al. 2015). Hong Kong has a slightly higher proportion of non-marital births at 8% (OECD Korea Policy Centre 2018; Gietel-Basten and Verropoulou 2018). While there are no statistics for extra-marital births in China, there are good reasons to believe that the share in that country is also extremely low because of the traditional family values and the social stigma attached to such births in Chinese society. A substantial increase in non-marital childbearing in East Asia is unlikely in the foreseeable future, as the shares of non-marital births in these countries have been increasing very slowly since the 1970s, shifting from 2% to 4% in Taiwan and from 1% to 2% in Japan (The National Institute of Population and Social Security Research 2018). Overall, childbearing is not an option for many unmarried women who want to have children in East Asia, because having a non-marital birth brings disgrace upon the family.

The persistent low period fertility rates observed in East Asia represent the combination of a strong tempo effect and a fertility-suppressing quantum effect that comes from declining marriage rates. From a cohort perspective, the completed fertility levels of *married* women remained at about two children for the cohorts born in the 1960s and the early 1970s in Taiwan (author's own calculations using the 2012 KAP survey) and for the 1960s birth cohorts in Japan (The National Institute of Population and Social Security Research 2018). However, the CTFR for the late 1960s birth cohorts are just 1.8 in Taiwan and 1.5 in Japan due to increasing childlessness resulting from non-marriage. Hence, even if all delayed marriages (and thus births) could be recuperated at older ages by late-marrying women, the increasing share of women who remain single beyond their reproductive ages across cohorts will make a reversal in fertility rates a challenging goal. This pattern is very different from the trends observed in European low-fertility societies, where decreases in fertility rates associated with declines in marriage have often been offset by sizeable shares of births out of wedlock. This being the case, one might wonder how such low rates of non-marital births square with rising sexual freedom and delayed marriage among young adults in East Asia. Indeed, when pre-marital pregnancies do occur, the common practice in the region has been to legitimise the births through matrimony, although many unplanned pregnancies might have been aborted.

3.3.3 Rising prevalence of bridal pregnancies

Figure 8 shows the share of bridal pregnancies (or "shotgun marriages") since 1970. Most studies define bridal pregnancies as births that occur within eight months after the date of marriage. Due to differences in analytical methods and data formats, the lines in Figure 8 reflect the share of bridal pregnancies by either marriage cohort or birth cohort. The prevalence of bridal pregnancies has been rising in recent decades in all of these societies, ranging from about 10% of births in Hong Kong to as high as one-third of births in Taiwan. However, while bridal pregnancies are becoming increasingly common, what percentage of pre-marital conceptions end in abortion remains unclear, even though a recent report has estimated that 33%

Figure 8:
Percentages of bridal pregnancies by birth or marriage cohorts



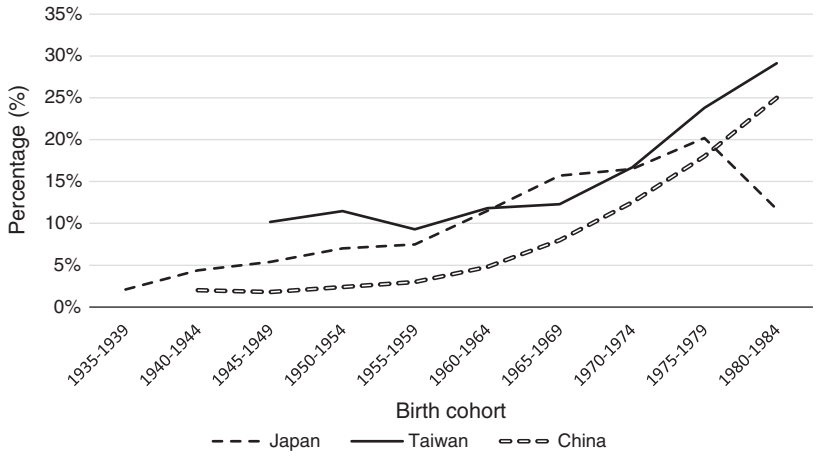
Source: Birth registration data and Statistical Yearbook of Taiwan; Kim and Lee (2018); Iwasawa and Kamata (2014); Ministry of Health, Labor and Welfare https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/tokusyu/syussyo06/syussyo2.html#02; Gietel-Basten and Verropoulou (2018).

of all pregnancies in East Asia in 2010–2014 ended in abortion (The Guttmacher Institute 2019). The patterns described here point to the persistence of cultural norms that place a high value on female chastity, see marriage as *the* ideal context for childbearing and strongly disapprove of non-marital births. This is a vivid example of a region where the modernisation narrative — i.e. that family diversity and unconventional family practices tend to follow economic development — does not hold. In the case of East Asia, it appears that conventional family practices are rather deeply ingrained.

3.3.4 Relatively low rates of cohabitation

With pre-marital pregnancies surging over the years, it seems reasonable to assume that the prevalence of cohabitation has been increasing as well. While cohabitation in East Asia appears to be more common than it was in the past, levels of cohabitation are still much lower in the region than they are in most of the other highly developed countries. Indeed, cohabitation remains a frowned-upon living arrangement among many Asian parents. Thus, when young adults move in with a partner, they often have to conceal it from their parents. The unconventionality of cohabitation is further reflected in the fact that statistics on cohabitation are not

Figure 9:
Percentages of ever cohabited among all women by birth cohort



Source: Author's own calculations from KAP survey of Taiwan, 1998 and 2012; Tsuya (2006); Yu and Xie (2015).

always readily available in this region. For instance, there seem to be no reliable cohabitation statistics for Hong Kong or Korea (Yoo 2015). It has been estimated that in 2004, the period rates of ever experiencing cohabitation were 10–15% in Japan and roughly 20% in Taiwan (Lesthaeghe 2010; Raymo et al. 2009). From a cohort perspective, the prevalence of cohabitation has been rising steadily in Taiwan (author's own calculations based on the 1998 and 2012 KAP surveys), Japan (Tsuya 2006) and China (Yu and Xie 2015) among women born after 1950 (see Figure 9).

Although the prevalence of cohabitation is unknown in Hong Kong, a report from the The Family Planning Association of Hong Kong (2017) indicated that the share of young adults aged 18 to 27 who agreed with the statement "I will cohabit before marriage" had increased from 13% to 24% among women and from 21% to 34% among men between 1996 and 2016. In Korea, public opinions regarding cohabitation remain relatively reserved and conservative. A survey of 253 cohabiting men and women in Korea aged 18–49 found that nearly 89% believe that Korean society is not favourable towards unmarried cohabitation (Byoun 2017). Moreover, the social stigma associated with cohabitation appears to be highly gendered in Confucian Korea: cohabiting women are perceived negatively because of concerns about female chastity and virginity, whereas cohabiting men are considered unfilial for failing to continue the family lineage through marriage (Yoo 2015).

The four unique characteristics of East Asian fertility mentioned above are closely linked to a patriarchal structure based on family lineage through sons, strong parental authority, an emphasis on women's chastity (i.e. sanctions for pre-marital

sex and "illegitimate" births outside of marriage) and the belief that women are obliged to bear sons to continue the patrilineal bloodline. In the next section, we will outline the commonly studied causes of East Asian low fertility, followed by a more focused discussion of how Confucian culture in the region supports the persistence of a patriarchal family system and a social context that emphasises credentialism through heavy investments in education and exam preparation. Both of these factors have made childbearing and childrearing burdensome for the younger generations.

4 Causes of ultra-low fertility in East Asia

4.1 Existing explanations

Since fertility in East Asia dipped below replacement level, a growing literature has sought to provide explanations for the rapid and pervasive changes across the region (Feeney 1994; Jones 2007, 2013; Straughan et al. 2008; Frejka et al. 2010; Ogawa and Shah 2015; Gietel-Basten 2018; Poston 2000). Some of the most common explanations include industrialisation and rapid economic development, educational expansion and increasing labour force attachment among women, the introduction of effective family planning programs, the lack of sufficient welfare policies that support families and a globalised economy that brings rising uncertainties for the younger generations. The first three factors have been linked to marital fertility decreasing to near-replacement levels in the initial stages of the fertility transition; while the last two factors have become more salient as fertility levels have declined to ultra-low levels.

Indeed, industrialisation fuels the demand for skilled labourers, which often leads to educational expansion, and which, in turn, increases women's labour force participation in market economies. Higher levels of labour force attachment cause people to delay marriage and thus shorten their reproductive life span. The market economy has also led couples to prefer a smaller family size, shifting their focus to child "quality", and to the ability of their children to compete in education and employment. Changes in the timing of marriage and in the desired family size have both contributed to a decline in fertility levels. In addition, as women gain economic independence, their mating preferences and marriage expectations tend to change, which leads to more lifelong singlehood and further fertility declines in contexts in which non-marital births are limited. After years of delayed and decreased childbearing, whether there is an eventual rebound in fertility and whether there is a pervasive decline in family size become the key factors that differentiate societies with near-replacement fertility levels from societies with sustained very low fertility levels. In such contexts, adequate government support for families also becomes of paramount importance.

Young adults in many low-fertility countries are discouraged from having children by insufficient family support from their governments, precarious labour market

conditions and economic instability in a globalised world. While stable employment and income accumulation remain important prerequisites for family formation in East Asia (Fukuda et al. 2020), more and more young adults are taking a longer period of time to establish themselves as "ready for marriage and parenthood"; particularly men, who are still expected to be in good economic standing to be considered marriageable partners (Yoshida 2017). When these pressures are combined with the lack of affordable housing in major East Asian cities (McDonald 2009), it is clear that family formation is becoming more arduous for young adults. Governments in East Asia have been particularly sluggish in formulating pronatalist family and labour policies that would alleviate the burden of childbearing and childrearing faced by parents. This is because caring for the young and the old has long been considered a family responsibility in collectivist societies. Moreover, the initial social responses to fertility decline in patriarchal societies are often to blame young people, and especially young women, for not fulfilling their duties. These mentalities and ideologies represent additional fertility-suppressing contextual and cultural factors that keep certain societies trapped in very low fertility for prolonged periods of time. In other words, limited state support for families provides only a partial explanation for why East Asian countries have lower fertility than other countries with similar policies, such as the German-speaking countries and Southern Europe. In East Asia, an ingrained Confucian culture that embraces patriarchy and credentialism appears to be at the root of declining marriage rates (and childbearing incentives), and the high cost of raising children seem to be directly or indirectly linked to the region's current low fertility levels. In the next section, we will probe these issues further by tracing the historical origins of Confucian influences that shape the social ethos in East Asia, and by examining the question of how this cultural milieu influences social and individual adaptations to rapid demographic transitions.

4.2 Confucian culture: patriarchy and credentialism

The teachings of Confucius have influenced Chinese society for more than 2000 years, since Confucianism became the official state religion and national ruling ideology during the Han dynasty (206 B.C.–220 A.D.). These teachings provide ethical and moral principles for social relationships and political governance in an imperial context. These principles serve as the core foundation of all interpersonal relationships and consolidate the legitimacy of the ruler (emperor). Interactions within the family and in the workplace are regulated by Confucian doctrines as hierarchical and patriarchal (Jackson et al. 2008). These teachings also gave rise to an exam-driven educational system, which used to be crucial for recruiting civil servants into the central government. As fame and fortune was increasingly attached to civil servant positions, the pursuit of secular success through academic excellence became highly valued in China (Weber 1958).

4.2.1 Patriarchy

The family systems in Confucian societies share a number of key characteristics. On the one hand, the patrilineal kinship system practices patrilocality as a normative post-marital living arrangement. A woman typically moved into the home of her husband's family after marriage and shouldered the responsibility of taking care of her parents-in-law. As inheritances were passed down to sons, a strong preference for sons became the norm. Thus, parents had few incentives to invest in their daughters, particularly in agrarian contexts. As sons were given more educational opportunities than daughters, many women were illiterate and uneducated. Since women lacked education and employment opportunities outside of the natal home, marriage became the expected "career" for women, and took place quite early in adolescence. In addition, the emphasis on chastity and virginity encouraged early marriage and further limited women's life course development. In such societies, women had limited agency, and their lives were largely confined within the domestic sphere. Thus, for a woman, housekeeping and childrearing were considered her primary lifelong responsibilities, and how well she fulfilled these tasks in the eyes of her family often defined her status in old age. Even today, many families still treat sons and daughters differently, though they may be given similar educational opportunities.

On the other hand, the Confucian family system is also based on a patriarchal order that closely monitors the decisions and behaviours of the young and women (Jackson et al. 2008). Children are expected to obey their parents. These hierarchical parent-child relationships form the core of "filial piety", which is considered virtuous, and has been instilled in generations of young children. It is expected that the parents' opinions and decisions regarding key events in the lives of their children, like marriage, will not be challenged. In addition, married young women occupy a subordinate position in the family, and it is traditionally considered virtuous for a woman to obey her parents-in-law and her husband. In both the pre-modern and the modern era, a married woman could be expelled from her marital home if she acted against the wishes of her parents-in-law or husband. An expelled woman is considered a disgrace to her natal family, and generally receives no support. In fact, the teaching of the "three obediences" for women makes clear the role a woman is expected to play throughout her life: i.e. a woman should obey her father as a daughter in the natal home, her husband as a wife in the marital home and her son(s) in widowhood. This teaching has cast a long shadow over women's status in Confucian societies. In contemporary East Asia, the happiness of a married woman often depends on her relationship with her parents-in-law, which can be tough to manage when intergenerational value clashes occur.

4.2.2 Credentialism

The legacy of Confucianism was perpetuated through competitive imperial civil service examinations over a period of around 1000 years. Since the 6th century, the

classical texts have been the contents of state examinations. Confucius temples were set up to teach Confucian classical texts, which had been essential to the education of the elite class in China. Later on, during the Song dynasty (960–1279 A.C.), the imperial examinations became more institutionalised and levels of fairness and competitiveness increased. Thus, among generations of Chinese people, social mobility through civil service examinations came to be seen as a route to success. The legacy of these exams has continued to shape how education is designed and delivered in contemporary periods. This 1000-year-old state examination system has contributed to the homogeneity and the stability of Chinese civilisation, and it has also contributed to the belief in credentialism.

The profound historic influence of the civil service exam is still evident today in the pervasive embrace of credentialism and the low regard for vocational education and craftsmanship in Confucian societies. Academic success in the educational system is considered a life goal that is of paramount importance in numerous families, with parents doing their best to make sure that their children advance as far as possible academically. As Max Weber (1915) once pointed out, "For twelve centuries social rank in China has been determined more by qualification for office than by wealth" (Weber 1958). In the ancient past, the poor and the rich were equally eligible to compete for a few coveted government positions that guaranteed a lifetime of prestige and prosperity. The successful exam-takers were rewarded with tremendous social status and wealth in a system that was designed to promote social mobility and to give rise to an elite class of scholar-bureaucrats or literati. This elite class was held in high regard, and was looked upon much more favourably by the public than farmers, merchants, engineers, or artisans. The high status of this class is reflected in a common saying that goes, "Scholarship pursuit surmounts all other occupations". As a result of this history, credentialism has become an integral part of the East Asian mentality, with academic performance being seen as *the* path to secular success.

4.3 The impact of Confucianism

The influence of Confucianism on social and family relationships, as well as its emphasis on exams and education, spread beyond the borders of China and reached the nearby countries of Japan and Korea around the third and fourth centuries. The institutional diffusion of Confucianism has left an indelible imprint on the social, psychological and educational systems in larger East Asia, and it explains why the family practices and educational systems in the five societies under discussion share so many common traits. The Confucian model of higher education that prevails in contemporary East Asia (Marginson 2011) refers to a state system of examinations and mass education that has reinforced families' long-standing commitments to education, and that has provided the skilled labour needed for economic growth. In the following sections, three issues related to the Confucian patriarchy and credentialism will be further discussed as proximate

determinants of the decades-long low fertility levels in East Asia. That is, the ingrained patriarchal mindset in East Asia has made changing the traditional domestic division of labour a rather slow process and has reduced the efficiency of pronatalist policies. The belief in credentialism has placed considerable pressure on new parents in post-industrial societies in which the costs of education and childrearing are high, and competition in the labour market is becoming ever fiercer.

4.3.1 Women's role at home

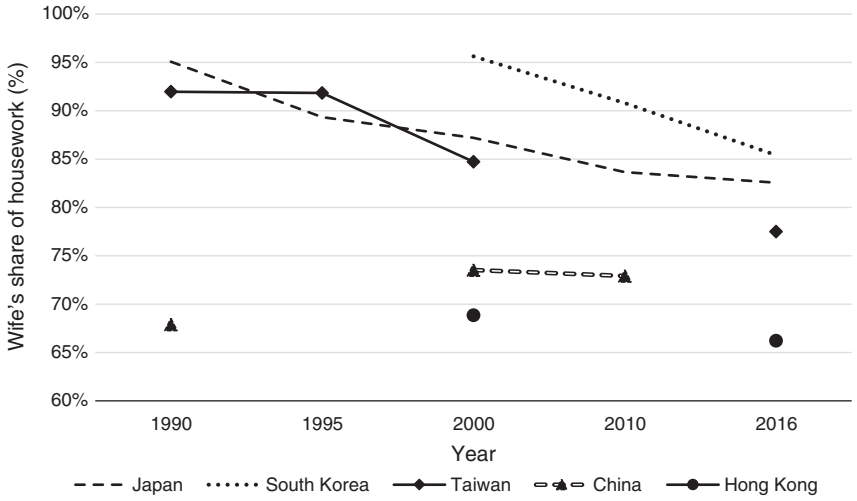
In East Asia, a gendered division of labour has persisted in the modern era, even as women's levels of education and labour market participation have increased sharply. In the past, when women had much less education and far fewer career prospects than men, the life course of the great majority of women was defined by their role as a housekeeper. Even today, the arrival of a new-born in a family substantially increases the woman's domestic workload, while it rarely affects the man's share of the domestic tasks (Gjerdingen and Center 2005; Kim and Cheung 2019). Despite their rising socio-economic status in recent decades, women have continued to shoulder the bulk of domestic chores in all five East Asian societies (Figure 10). While progress towards a more egalitarian division of labour has occurred, it has been slow. In 2016, married women in East Asia were, on average, still performing between two-thirds (Hong Kong) and 85% (Korea) of all domestic chores.

In addition to the double burden of work and family, the persistence of a preference for sons is another source of role strain for married women in contemporary East Asia. For instance, even though the overall sex ratios at birth in Taiwan have decreased from a high of 111 to 107 in recent years, the sex ratios for parity 2 and parity 3+ births are as high as 108–109 and 113–115 among tertiary-educated women born in the 1970s and 1980s. Moreover, these figures are even higher among women without tertiary education (author's own calculations based on the Taiwanese birth register data). In other words, some of the best-educated women in Taiwan who would appear to be more empowered by their socio-economic attainment have been unable to avoid perpetuating such practices.

Given how much educational and occupational progress women have made in recent decades, it seem inevitable that the persistence of a gendered division of labour and the pressure to bear sons create work-family role strain. Many women feel forced to choose between career and family, as they are offered few options for combining the two. In light of the numerous familial obligations that are imposed upon women after they get married, it is no wonder more and more East Asian women are deciding to opt out of the entire "marriage package" (Bumpass et al. 2009).

In the advanced East Asian economies of Japan, Korea and Taiwan, it is not only the native-born women who are having fewer children, but the many foreign brides who have married native-born men (often with lower socio-economic status). It appears that the arrival of these migrant women has not alleviated the very low

Figure 10:
Women's share of total housework hours



Source: Hsiao (2005); Hsu (2008); Kim (2017); Survey on Time Use and Leisure Activities (1996, 2001, 2006, 2011, 2016), Japan; Yang (2017).

fertility in their host countries. Despite the common public perception that migrant women have high fertility, the evidence indicates that in these three countries, foreign brides have fewer children than native-born women (Ishikawa 2015; Kim 2018; Yang et al. 2012). Given that these migrants often have at most a high school degree and limited career prospects, it is rather paradoxical that their fertility rates are lower than those of native-born women, who likely have more work-family conflicts. The research on this issue has observed that foreign brides often experience conflicts stemming from discriminatory treatment (Lee 2016; Yang et al. 2012), such as the patriarchal expectation that they will bear children combined with social prejudices about the "quality" of their offspring (Hsia 2007). In addition to living in a low-fertility context, these conflicts could make it difficult for migrant women to have more children, and could partly explain their low fertility.

4.3.2 Efficiency of pronatalist policies

East Asian governments in general have been slow to adopt pronatalist policies. This hesitation is partly rooted in their collectivist attitudes and commitment to strong family structures; i.e. the belief that the responsibility for child care should fall on the shoulders of family members (particularly women) and not on the government. Paid parental leave policies started appearing in most East Asian countries roughly two to four decades after the TFR dropped below replacement level: in 1996 in

Japan, in 2001 in Korea and in 2009 in Taiwan. Over the years, parental leave provisions have become more generous, with the pay scale and the length of leave benefits gradually increasing in Japan, Korea and Taiwan (Lee and Lin 2016; Sano and Yasumoto 2014; Lee 2009). While maternity leave was introduced earlier than paternity leave in Japan and Korea, the two countries now have among the most generous paid paternity leave policies (i.e. 52 weeks) in the OECD (OECD 2019).

Although government investments in these pronatalist policies have been increasing, the uptake of leave has been extremely low among fathers, and, at times, even among mothers. This is likely due to traditional values regarding the gendered division of labour, the fear of repercussions from employers, and the fact that it is more "costly" for men to take parental leave because of the gender wage gap. These rigid labour market structures and workplace norms often force new parents to continue to work long hours, and deter them from taking parental leave (Brinton and Oh 2019). These lower leave uptake rates have further perpetuated the gendered division of labour, and have, in turn, reduced women's (mothers') intentions to have (more) children. By 2017, the paid parental leave uptake rates among eligible mothers were 83% in Japan, 76% in Taiwan and only 22% in Korea. In stark contrast, the share of eligible fathers who used parental leave in 2017 was a mere 3% in Japan, 5% in Korea and 8% in Taiwan (The Ministry of Health Labor and Welfare 2019; Ministry of Employment and Labor 2019; Ministry of Labor 2019). The low levels of leave uptake among mothers and fathers in Korea are particularly striking, and suggest that the country has a workplace culture that discourages new parents from enjoying such benefits. Indeed, past research has shown that the institutional culture in companies and the prevailing social values are the main impediments to higher rates of leave use in Japan and Korea (Brinton and Mun 2016; Mun and Brinton 2015; Steger 2018). Moreover, it appears that parental leave policies have led to "negative compliance" among some Japanese firms, which have reduced the number of women they recruit in response to growing family leave requirements (Mun 2015).

4.3.3 The burden of human capital investment

Even though the majority of East Asian societies have greatly modernised and now have a much more diversified occupational structure than is found in feudal and agrarian contexts, many parents still consider academic excellence a necessary condition for having a successful and happy life. The rise of the knowledge economy has only intensified the perceived need for academic achievement. The cultural and historical ethos of family commitments to education are realised through contemporary exam-driven education. This system is at the root of some recent efforts to explain very low fertility in the region, such as claims that these societies have "education fever" (Anderson and Kohler 2013), are engaged in an educational "arms race" (Jones 2019) or are "success-oriented" (Ogawa et al. 2015). Coupled with the collectivist culture in this region, East Asian parents are often

held responsible for their children's school performance, which is linked to the "face" of the family. Hence, parents are expected and willing to invest considerable financial resources in their children's education. In the early 2000s, the shares of total per capita educational costs for children and youths under age 24 that were paid for privately by parents reached as high as 50% to 70% in Taiwan, Korea and China (Ogawa et al. 2015). Moreover, families in East Asia pay much larger shares of the costs of tertiary education than their counterparts in other OECD countries (Marginson 2011).

Investment in education can be multi-dimensional. Due to the legacy of a classical-text learning culture, the school curricula in East Asia often follow a standardised program with well-defined materials for each subject field. Students are expected to show their mastery of these materials in exams. Helping their children improve their learning outcomes by enrolling them in after-school shadow education (i.e. cram school) is considered indispensable by many parents. In addition, as participating in extracurricular activities boosts the chances of university admission, parents often invest heavily in their children's education outside of school. All of these efforts are centred around preparation for the university entrance examination, which is a particularly stressful and competitive process for parents and children alike. While preparing for these exams can be very arduous, students who excel in them are admitted to prestigious elite universities, which can bring tremendous joy and glory to their families. Although public education in most East Asian societies is not costly, the large human capital investment parents often make in their child's shadow education, extracurricular activities and private university tuition (if the child is not admitted to a public university) mean that having children is a long-term financial burden for parents. These costs inevitably enter into couples' calculations when they are considering having children.

Indeed, existing research has indicated that spending on children is negatively associated with period total fertility rates in Japan, Korea and Taiwan (Ogawa et al. 2015). In particular, there is evidence that a decrease in the TFR leads to little change in the total cost of childrearing per adult, which suggests that there is a strong quality-quantity trade-off in fertility behaviours among East Asian parents. It has also been shown that private transfers to children and youths increased substantially from the mid-1980s to the mid-2000s in East Asian countries (Ogawa et al. 2015; Tung 2011). Thus, it appears that when living standards, education expenses and employment instability in a globalised economy are all high, fertility intentions are substantially attenuated.

5 Social changes in Confucian societies

Based on the patterns and causes of East Asian fertility decline discussed above, we can argue that the very low fertility levels in the region are largely the result of both continuity and changes in traditional values. On the one hand, Confucian patriarchal values still strongly influence people's decisions surrounding intimate

relationships and family formation, such that non-marital birth rates and the prevalence of cohabitation have remained very low. The underlying mindset is characterised not only by an emphasis on women's chastity, but on marriage as *the* ideal setting for childbearing and childrearing. On the other hand, in recent decades, attitudinal changes have been taking place across these societies to varying degrees and particularly in terms of people's views on women's roles, marriage, marital childbearing and old-age support. The analyses that follow will show that common public discourses asserting that young people have low fertility intentions because they are selfish and materialistic perpetuate myths, and do not accurately reflect young people's values. In fact, many of these discourses are still based on Confucian moral codes, even though these teachings have become increasingly incompatible with the rapidly changing world young people are now facing.

Using data drawn from the 2006 and 2016 East Asian Social Survey[5] (EASS), Table 2 shows the percentage of respondents of marriageable ages (i.e. aged 20–49) who agreed with eight statements about marriage and family values. The response values are on a seven-point scale, ranging from strongly disagree (=1) to strongly agree (=7), with neither agree nor disagree (=4) in the middle. Hence, the figures in Table 2 (percentage of respondents agreeing with a statement shown) refer to those who answered with values ranging from five to seven. The two survey years of 2006 and 2016 are the only two time points when the EASS family modules were administered.

Although the public opinions revealed in Table 2 reflect changes over one decade only, they offer comparable attitudinal measures for four East Asian countries with a Confucian heritage. We can see that, overall, family values were shifting towards more liberal attitudes, even though they fell short of catching up with the speed of women's socio-economic progress. The figures show that attitudes towards gender roles (item 1), union formation (items 2–4) and childbearing (items 5–6) had become more non-traditional, even though the attitudinal changes in family obligations (items 7–8) were relatively minor. As fewer respondents endorsed the traditional breadwinner-housekeeper model, more respondents also considered cohabitation without a marriage plan an acceptable option. Moreover, married people were not rated as happier than singles. Levels of acceptance for childless marriage increased, while the preference for sons declined over time. The pace of change in views about cohabitation and childless marriage is particularly notable. Among the four East Asian countries studied, the South Koreans stand out as having the most traditional attitudes and adhering to more conventional family values, while also displaying the most rapid attitudinal changes on the first six of these eight items. These findings are in line with the results showing that the percentage of Korean men and women who were lifelong single also began to increase later and rose

[5] The EASS is a cross-national and biennial social survey project that aims to promote comparative studies on social lives in East Asia. Since it was launched in 2003, the EASS has completed two waves of family surveys.

Table 2:
Percentage of respondents aged 20–49 agreeing with statements of family and marriage values in four East Asian countries

		China		Japan		Korea		Taiwan	
	Year	Men	Women	Men	Women	Men	Women	Men	Women
1. A husband's job is to earn money; a wife's job is to look after the home and family	2006	**55.4%**	**54.1%**	29.5%	24.2%	39.4%	26.9%	46.2%	33.7%
	2016	**39.9%**	**38.2%**	14.2%	13.4%	20.1%	15.3%	35.8%	22.5%
2. It's alright for a couple to live together without intending to get married	2006	31.1%	26.4%	38.5%	42.5%	**25.8%**	**24.2%**	42.0%	48.4%
	2016	**23.9%**	**23.3%**	60.9%	64.5%	42.2%	39.4%	67.0%	67.2%
3. Married men are generally happier than unmarried men	2006	38.7%	38.3%	28.5%	21.1%	**60.6%**	**56.6%**	32.2%	34.2%
	2016	33.7%	32.0%	21.0%	17.3%	**45.0%**	**45.3%**	32.8%	31.1%
4. Married women are generally happier than unmarried women	2006	39.0%	36.9%	26.5%	21.7%	**54.9%**	**49.1%**	28.7%	25.0%
	2016	34.5%	30.2%	20.5%	18.1%	**38.6%**	**38.3%**	30.5%	25.0%
5. It's not necessary to have children in marriage	2006	29.2%	30.2%	24.6%	29.9%	**8.9%**	**12.6%**	33.9%	45.8%
	2016	**19.0%**	**27.1%**	38.6%	53.9%	19.7%	28.5%	53.7%	61.7%
6. To continue the family line, one must have at least one son	2006	44.2%	40.3%	41.8%	25.6%	**58.8%**	**38.2%**	44.8%	27.4%
	2016	40.2%	**34.8%**	33.4%	20.6%	30.9%	17.2%	**44.2%**	32.3%
7. A married adult man ought to provide financial support for his own parents	2006	89.2%	88.2%	69.0%	49.4%	89.0%	83.8%	**91.7%**	**89.2%**
	2016	91.0%	88.9%	61.3%	57.9%	85.5%	72.6%	**91.8%**	**89.5%**
8. A married adult woman ought to provide financial support for her own parents	2006	**87.7%**	**86.8%**	49.7%	40.9%	80.1%	78.8%	62.9%	76.8%
	2016	**88.2%**	**87.2%**	51.9%	53.3%	82.3%	72.3%	79.8%	85.8%

Source: The East Asian Social Survey, 2006 and 2016. Bolded figures indicate the most conservative groups in a given year.

more slowly than it did the other three advanced East Asian economies in Figure 6; and that Korean women still shoulder 85% of total household chores, which is by far the highest level among the five societies analysed in Figure 10. In addition, both the unavailability of cohabitation statistics (Yoo 2015) and the very low non-marital birth rates (Raymo et al. 2015) in Korea point to the stigma and the undesirability of non-conventional family formation in that society. The highly traditional social milieu in Korea stands in stark contrast to the remarkable rise in the percentage of tertiary-educated Korean women aged 25–29, as shown in Figure 3. This is likely one of the key factors driving attitudinal changes and the reason why the TFR keeps declining in South Korea, reaching a record low of 0.92 children per woman in 2019, despite the government's heavy investments in various pronatalist policies since the turn of the new millennium (Lee and Choi 2015). In short, when a society retains views on women's roles that originated in a context in which women were less educated and had limited career prospects, younger cohorts of well-educated women will inevitably face more repercussions when they attempt to pursue non-traditional life goals. This certainly has implications for their family behaviours, because they might be considered less desirable potential marriage partners and mothers and have to shoulder much higher opportunity costs of childbearing.

6 Recent policy responses and the future of fertility in East Asia

Even though the fertility transition to below-replacement levels occurred later in East Asia than it did in most of the Western developed countries, the speed and the scope of these demographic changes have been greater in East Asia than they were in the West. While it took about 50 to 80 years for Western developed nations to reach the threshold of people aged 65 or older making up 20% of the population, Japan took only 33 years to reach this point, and it could take even fewer years for Taiwan and Korea to reach this threshold. Except in China, where marriage remains near-universal for women, the ultra-low fertility levels in East Asia were initially driven by declining marital fertility rates and delayed childbearing, and then by decreasing marriage rates in the absence of non-marital births. Along with the persistence of patriarchal culture, the high costs of raising children and the limited availability of public child care have led people in East Asia to have fewer children and to form fewer marital unions than in the past. The shares of women who were still single at age 50 have been rising since the 1990s in all advanced East Asian economies (and in Japan, since 1970s) (Figure 6). Thus, how fertility in this region develops in the future will be influenced by the evolution of matrimonial behaviour over time, and by whether attitudinal changes de-stigmatise non-marital childbearing.

It appears that one of the reasons why so many young people stay unmarried is that they feel they are neither able nor ready to have children. This could be

because the direct costs of childrearing are too high, or simply because they want to stay away from a patriarchal marriage system that is too stressful and involves too much personal sacrifice. The high costs of raising children can be ameliorated by providing child care subsidies, inexpensive public child care, or even free education, and by implementing more comprehensive economic policies that help young workers escape the low-wage trap they are currently facing in East Asia. But changing the marriage system is hardly attainable by policies alone. Given that childbearing is considered an unquestionable moral duty in patrilineal East Asia, newlywed couples often get bombarded with inquiries about their childbearing plans by parents and family members from both sides. This can be stressful for men and women who are employed in competitive market economies, and particularly hard to bear for women in families in which there is a strong preference for sons. In the case of Taiwan, the sex ratios at birth are still 108–109 for parity 2 and 114 for parities 3 and above, even among the younger cohorts born in 1980–1989 (author's calculations using birth register data in 1998–2016). Hence, when we look at why marriage rates have been declining in recent decades, it becomes clear that the social mentality and the prevailing norms about marriage and childbearing are incompatible with the empowerment and the rising agency of women. Young adults in East Asia should be given more flexibility to form families: i.e. partnership formation, marriage and childbearing should have no strictly defined timing or order; and these events should promote, rather than attenuate, their personal well-being.

In addition to suffering from norms of gender inequality and relatively rigid life choices, women face prevailing marital age preferences that often discriminate against them after they reach age 35. This is likely due to women's declining fecundity over the life course (Wood 1994), since continuing the family bloodline is considered a crucial purpose of marriage in East Asia. In the case of Taiwan, the marriage life tables generated by the 2015 age-specific marriage rates (see Table 3) indicate that the probabilities of marrying at ages 30–34 among those individuals who were single at ages 25–29 were quite similar for men and women across educational groups, but also that the comparable probabilities of marrying at ages 35–39 were much higher for men than for women with tertiary education. These gender gaps in marriage further widen when people reach their early forties: at this point in the life course, about one-fifth of single men but fewer than 8% of single women with tertiary education can still expect to marry. With the expansion of tertiary education and the rising mean age at marriage in recent decades, this age prejudice can have considerable implications for future fertility levels in East Asia. First, shrinking cohort sizes and unbalanced sex ratios will create a substantial marriage squeeze to the disadvantage of men that will lead to fewer marriages and fewer childbirths, if non-marital births remain scarce. Second, with late motherhood stretching to above age 40 in many low-fertility societies (Beaujouan and Sobotka 2019), the low marriage rates among women beyond conventional marriageable ages in East Asia would make a potential fertility reversal much less likely in the future.

Table 3:
Life table estimates of probability of marrying by age *X* for women not married at age *Y* across educational levels, Taiwan 2015

		Men				
Age *X*	**Age *Y***	**< High school**	**High school**	**Junior college**	**College+**	**Total**
30–34	25–29	0.2252	0.2985	0.4101	0.4321	0.3699
35–39	30–34	0.1530	0.2139	0.2905	0.3786	0.2734
40–44	35–39	0.0917	0.1214	0.1693	0.2215	0.1474
		Women				
Age *X*	**Age *Y***	**< High school**	**High school**	**Junior college**	**College+**	**Total**
30–34	25–29	0.3747	0.3678	0.4472	0.4463	0.4266
35–39	30–34	0.2469	0.1996	0.2222	0.2437	0.2283
40–44	35–39	0.1435	0.0739	0.0752	0.0789	0.0829

The prospects for fertility in East Asia can also be evaluated by using a recent forecast on levels of singlehood in East Asia. To gauge marriage patterns, Esteve et al. (2020) conducted a marriage forecast for four East Asian countries from 2010 up to 2050. They assumed that the prevailing marriage norms observed in 2010 will persist until 2050. The 2010 age- and educational-specific marriage propensities (Schoen 1988) were then applied to the projected population structure by age, sex, education and marital status up to 2050. The results indicated that lifelong singlehood among women aged 45–49 will likely reach 15% in Korea and Japan and nearly 30% in Taiwan; but a much lower level in China, which is expected to continue to have a universal marriage regime. Assuming that non-marital birth rates stay as low as they have been since 1970 in East Asia, married women will need to have about 2.1 children in Japan and 2.6 children in Taiwan for these countries to achieve a CTFR of 1.8 in 2050 — much less a level closer to replacement. Given that the marital fertility rate among the 1975 cohort in Taiwan is about 1.9 children (with a forecasted CTFR (1975) of 1.55, assuming 20% of women never marry), a substantial increase in either the marriage or the marital fertility rates will be required for a demographically sustainable fertility level to occur.

Cultural and institutional factors are at the root of the sustained ultra-low fertility levels in East Asia. As significant demographic changes took place in the region within a short period of three to four decades, a clash of values has inevitably occurred between the older and the younger generations. To be more specific, low fertility in East Asia has been accompanied by declining marriage rates and minimal non-marital births largely because Confucian family norms continue to influence the socially acceptable timing and sequence of family behaviours. These rigid norms hamper the emergence of new values and behaviours among young adults, who are

facing an increasingly diverse set of options and trajectories in life. For example, while prolonged education can substantially affect the timing of people's economic readiness for marriage, these societies show little tolerance for marriage in the absence of financial readiness, or for non-marital births. These norms have left the younger generations with few choices other than to postpone or forego marriage (and thus childbearing), which eventually results in societies having persistent low fertility and high levels of lifetime childlessness.

On the other hand, the collectivist culture that views child care as the responsibility of the family led to East Asian governments providing little support for families. However, these governments became more active in implementing pronatalist policies that promote work-family balance around the 1990s (for Japan) and 2000s. These new policies included the expansion of the provision of child care and parental leave policies (Suzuki 2012; Lee and Lin 2016). More policies were introduced after 2010, when the TFR remained stuck below 1.5 children. For instance, South Korea has invested more than 70 billion U.S. dollars in supporting childbearing since late 2000s (Poon 2018). But even though these Korean pronatalist policies provide some of the world's most generous child care subsidies and paid parental leave (52 weeks), the TFR in Korea declined to a record low of 0.92 in 2019. In response to a shortage of high quality public child care for children under age six, the Taiwanese government launched a "quasi-public child care" program in six major municipalities in August 2018 that converted private facilities into more affordable "quasi-public" child care (Focus Taiwan 2019). That is, the government recruited private preschools and kindergartens and provided subsidies in exchange for monitoring their fees and operations, thereby making them more affordable to parents. In 2019, this program was further expanded to all 22 administrative regions in Taiwan, and an income tax cut for families with dependent children was enacted (Focus Taiwan 2019). Finally, in 2018, the Japanese government announced that it will make preschool education free from ages three to five beginning in October 2019 (The Japan Times 2019). In mid-September 2019, Prime Minister Abe indicated that Japan plans to cover educational and medical expenses for all children under age 16 starting in October 2019.

It is too early to assess the impact and the effectiveness of these recent new policies on fertility and marriage. Given that the fertility levels of married women range from two children in Taiwan to fewer than two children in Hong Kong, Japan, Korea and China, declining marriage rates and marital fertility are key issues faced by these societies. Whether these recent policies will make childbearing more affordable and, thus, marriage more feasible for young adults remains to be seen. The differences between the TFR and the CTFR discussed earlier (see Table 1) suggest that Taiwan, Korea and China have slightly more leeway than Japan and Hong Kong, as the cohort completed fertility levels at age 40 for those born in 1970 are 1.7–1.75 children for the former group, yet only 1.43 and 1.15 for the latter two countries. The critical issues now are helping married couples have the number of children they want and supporting unmarried adults in forming families. While the former aim could be tackled by the recently enacted family policies, the latter

goal will be hard to achieve before gender relations reach a more ideal state of equilibrium.

While replacement migration is a potential policy option for low-fertility countries, East Asian societies have not been particularly keen on pursuing this route. Migration policies in this region are often born out of expediency, and are seldom designed to increase diversity or to expand the young adult population. Even though the numbers of labour and marriage migrants to these countries have increased in recent decades, the labour migrants often face rigid governmental controls that prohibit them from settling (Piper 2004), while marriage migrants do not have more children than native-born women (Ishikawa 2015; Kim 2018; Yang et al. 2012). Thus, it appears that expanding immigration is not a policy choice that is likely to be adopted in low-fertility East Asia.

In short, in East Asia, population decline due to very low fertility levels is likely an inevitability. The causes of this phenomenon are not just insufficient policy support for families, but cultural and institutional factors that hamper family formation. While it takes time for more profound social transformation to happen, family forms have nonetheless diversified in East Asia as divorce rates have increased and cross-border marriages have become more prevalent in recent decades. With the legalisation of same-sex marriage in 2017 in Taiwan, it is possible to envision increasing family diversity in the years to come. The current ultra-low fertility observed in this region likely reflects a transitional state of social maladaptation to women's new roles and rapid family changes. In addition to policies that promote childbearing, governments in East Asia should think about how they can sustain or improve the well-being of their citizens in an ultra-low fertility context. While most existing research on the obstacles to fertility in East Asia studied the married population (Gauthier 2016), obstacles to marriage among the single population (Yoshida 2017) are perhaps equally important in this region. That is, if the demographic realities we are facing now reflect reluctant and involuntary outcomes among the younger generations, governments should perhaps seek to build a more flexible and supportive environment that promotes family formation. If, however, the current low levels of fertility and of marriage represent desirable life choices among the younger generations, then the problems of low fertility and population ageing should probably be tackled from angles other than through pro-natalist policies, such as investing more in automation to counter the labour shortage and expanding migration to maintain a more sustainable tax base. After all, securing the welfare of the young and the old living in low-fertility contexts should always be the main policy priority.

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RESEARCH ARTICLES

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Laggards in the global fertility transition

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Abstract

Between the early 1950s and the present, the global fertility transition has been nearly universal in the developing world. However, as of 2017, two countries out of the 190 countries for which the United Nations provides fertility estimates had not yet met the conventional criterion for establishing the onset of the fertility transition (a decline of at least 10 per cent from peak fertility), and another five countries did so only very recently. These are the laggards in the global fertility transition. The countries are all in sub-Saharan Africa: Chad, the Democratic Republic of the Congo, Equatorial Guinea, The Gambia, Mali, Niger, and Somalia. This paper first reviews the fertility history of these seven countries, and subsequently provides data on the timing and pace of the global fertility transition in the four major developing regions: Asia, Latin America and the Caribbean, Northern Africa, and sub-Saharan Africa. It then explores potential reasons for the slow emergence of fertility decline in each country. The paper concludes with a discussion of each country's prospects for fertility decline, which generally are weaker than those in the projections of the United Nations.

Keywords: global fertility transition; laggards; sub-Saharan Africa; pace of fertility decline; factors influencing fertility

1 Introduction

Beginning for the most part soon after World War II and continuing up to the present, the global fertility transition has occurred in almost all countries throughout the developing world. However, among the 190 countries for which the United Nations (UN) produces estimates of fertility (United Nations 2017), there are two countries in which estimated fertility in 2010–2015 had not yet declined by at least

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10 per cent since peak fertility was observed. Hence, these countries have not yet confirmed that they have begun the fertility transition according to the Princeton rule (Coale and Treadway 1986; Bongaarts and Casterline 2013). These countries are the Democratic Republic of the Congo (DRC) and Niger.

In addition, there are five countries in which fertility did not fall to 10 per cent or more below peak until 2010–2015: namely, Chad, Equatorial Guinea, The Gambia, Mali, and Somalia. These seven countries are the laggards in the global fertility transition. Three are in Middle Africa (the DRC, Chad, and Equatorial Guinea), a laggard sub-region that itself did not meet the 10 per cent rule until 2010–2015; three are in Western Africa (Niger, The Gambia, and Mali); and Somalia is in Eastern Africa. As of 2015, the total population of these seven countries was almost 145 million, more than half of which was in the DRC. This combined population figure represented 15 per cent of the population of sub-Saharan Africa in 2015.

In this paper, we seek to identify the factors that have contributed to the unusually slow decline in fertility among these laggard countries. There is a large body of literature on the various factors that influence the pace of fertility decline in the developing world. Women's education, infant and child mortality, economic growth, urbanisation, entry into a union, religion, ideal number of children, and modern contraceptive use are all factors that have been associated with the pace of fertility decline. More rapid increases in women's education, greater declines in infant and child mortality, more rapid economic growth and urbanisation, delayed entry into a union, belonging to a non-Muslim religion, more rapid declines in the ideal number of children, and the greater uptake of modern contraception are all factors that have been associated with more rapid declines in fertility.

A principal aim of this paper is, then, to compare these variables in the laggard countries with those in other countries in sub-Saharan Africa in which the fertility decline has been initiated earlier, and is ongoing. Our basic hypothesis is that the laggard countries will differ from other countries in the region on one or more of these relevant factors, and that these differences will help to account for their slow pace of fertility decline. However, before we get to that exercise, we wish to provide a descriptive analysis with comparisons between the laggard countries on the one hand, and both other countries in sub-Saharan Africa and other countries elsewhere in the developing world on the other.

We begin in the next section of the paper by presenting a review of the fertility histories of the laggard countries from the early 1950s until the present, and compare them to those of all less developed countries and all countries in sub-Saharan Africa. In each of the laggard countries, the total fertility rate (TFR) increased from the early 1950s onwards (a phenomenon observed in many developing nations in the years following World War II); reached a peak in a quinquennium as early as 1975–1980 or as late as 1995–2000, depending on the country; and has since fallen. We also discuss the status of fertility decline in the DRC and Niger. The following section provides an overview of the global fertility transition, with information on the timing of peak fertility in the different developing country regions, as well as on the pace of fertility decline. In brief, the data show that peak fertility tended to occur distinctly

later in sub-Saharan Africa than in Asia, Latin America and the Caribbean, and Northern Africa; and that the time required for fertility to fall at least 10 per cent from that peak (i.e., an inverse indicator of the initial pace of fertility decline) was also considerably longer in most sub-Saharan African countries than in countries in other regions.

We then explore potential reasons for the slow fertility decline in each of the laggard countries. As noted above, we examine various factors that have been linked to fertility decline in previous research, including women's educational attainment, infant and child mortality, ideal number of children, levels and growth of GDP per head, Muslim representation, entry into marriage, and use of modern contraception. Levels and changes in these determinants should help explain why fertility in the laggard countries was so slow to decline from its peak level. The paper concludes with a discussion of the prospects for fertility decline in each of the countries.

2 Fertility trends 1950–2015

Because we wish to examine fertility over an extended period of time, we use estimates of fertility provided by the United Nations (2017). These estimates are the most comprehensive ones available, and go back to the middle of the 20th century. However, we acknowledge that because these estimates are in some cases based on limited data, they are subject to a degree of uncertainty. In particular, the identification of the quinquennium during which fertility reached its peak (shown for the laggards in Table 1) is subject to a comparatively high level of uncertainty. At the same time, because the estimates cover an extended period of time, we believe that the other measures that we use, such as the duration between peak fertility

Table 1:
Total fertility rates (TFRs) in 1950–1955, 2010–2015, and at peak, and quinquennium of peak

Country	1950–1955	2010–2015	Peak	Quinquennium of peak	Population, 2015 (millions)
Chad	6.10	6.31	7.41	1995–2000	14.0
Democratic Republic of the Congo	5.98	6.40	6.77	1990–2000[a]	76.2
Equatorial Guinea	5.67	4.99	5.98	1985–1990	1.2
The Gambia	5.29	5.62	6.34	1975–1980	2.0
Mali	6.95	6.35	7.15	1970–1995[b]	17.5
Niger	7.30	7.40	7.90	1980–1985	19.9
Somalia	7.25	6.61	7.70	1995–2000	13.9

Notes: [a]The TFR estimates were identical for 1990–1995 and 1995–2000. [b]The estimated peak TFR was constant for 25 years.

and achieving a 10 per cent decline from peak fertility – a process that takes a considerable amount of time – are less susceptible to measurement error.

A related data issue is our use of the relative decline to confirm the onset of the fertility transition (10 per cent below peak). We do so because it is a commonly used measure. An alternative would be to focus on the absolute decline. For example, we could examine countries where the TFR remains above a certain level. If we had looked instead at countries that had a TFR of 6.00 or above in 2010–2015, we would still have included five of our laggard countries plus Burundi, but we would not have included Equatorial Guinea or The Gambia. Our focus is on fertility decline; and in Burundi, the estimated TFR declined from 7.55 to 6.00. In our view, such a substantial decline is not indicative of a laggard country.

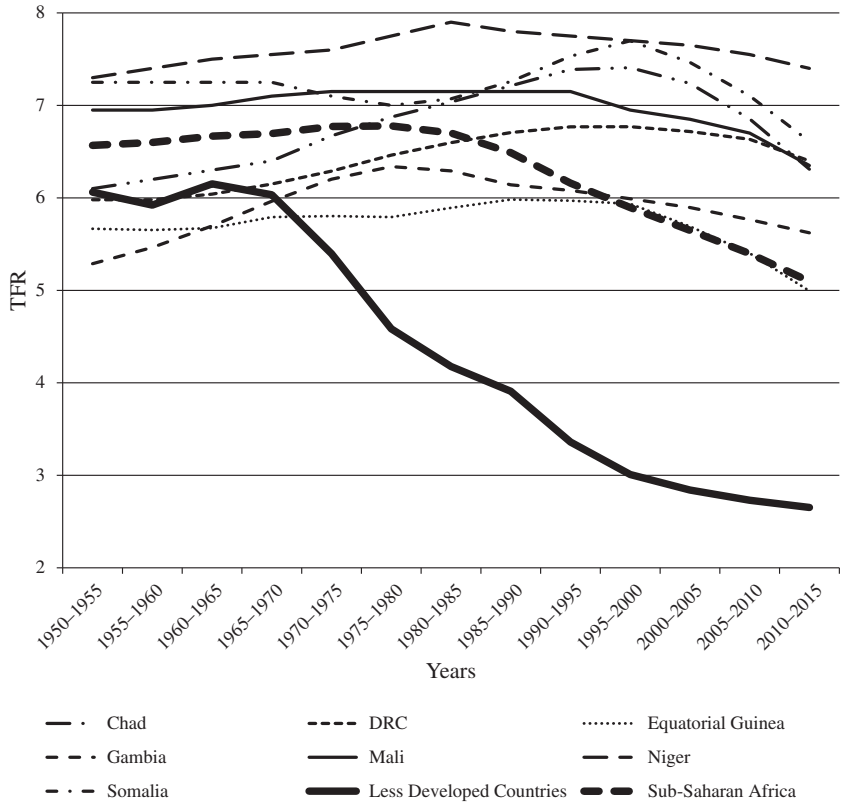
As Table 1 shows, in the early 1950s, the TFRs of the laggards ranged from about 5.3 to 7.3 for all seven countries. In the next 25–45 years, the TFRs rose in each country, and then subsequently fell. The declines from peak fertility to 2010–2015 were 5.5 per cent in the DRC, four per cent for Niger, 15 per cent in Chad, 17 per cent in Equatorial Guinea, 11 per cent in The Gambia and in Mali, and 14 per cent in Somalia. The last column shows that the DRC, the third-largest country in terms of population in the region, is the only large country in the group; while Niger, Mali, Chad, and Somalia are of medium size; and Equatorial Guinea and The Gambia are quite small.

In all of these countries, peak fertility was followed by monotonically declining fertility, in some cases for as long as 35 years. Indeed, monotonically declining fertility across quinquennia was observed throughout sub-Saharan Africa in the UN estimates, which suggests that cases of stalling fertility (Bongaarts 2008; Shapiro and Gebreselassie 2008; Ezeh et al. 2009) tend to be transient. Hence, even though as of the 2017 UN estimates the DRC and Niger had not yet met the 10 per cent threshold they needed to reach to be characterised as having initiated the fertility transition process, and despite the fact that the DRC experienced an increase in its estimated fertility between its 2007 Demographic and Health Survey (DHS) and its 2013–2014 DHS, it seems likely that for both countries, fertility will fall to at least 10 per cent below peak fertility in the near future. Indeed, this estimate is in line with the UN projections (2017), which anticipate that the DRC will reach the 10 per cent threshold during the 2015–2020 quinquennium, and that Niger will reach this level in 2020–2025.

Figure 1 shows the history of fertility since 1950 for each country, as well as averages for less developed countries and for sub-Saharan Africa. The figure is very crowded, but close examination reveals several interesting phenomena.

Consider first the laggard countries. The increases from the early 1950s to peak fertility levels, which were reached during the last quarter of the 20th century, were generally modest (less than 10 per cent), ranging from three to eight per cent for four of the countries – but were as high as 13 per cent for the DRC, 20 per cent for The Gambia, and 21 per cent for Chad. Various explanations have been proposed for this phenomenon of increasing fertility prior to the onset of fertility decline. One contributing factor was the shortening of durations of breastfeeding and postpartum

Figure 1:
Total fertility rates, laggard countries, less developed countries, and sub-Saharan Africa, 1950–2015



abstinence in the absence of the adoption of contraception (Romaniuk 1980; Lesthaeghe 1984). Second, it has been argued that the colonial economy, with its desire for cash crops, increased the demand for labour, and thereby encouraged high fertility (Mbacke 1994). Third, during the period under consideration, public health campaigns aimed at combating venereal disease (see, for example, Bruaux et al. 1957) served to reduce infertility among various ethnic groups throughout the region, and thereby contributed to increasing fertility. For the DRC, an important share of the increase in fertility is attributable to declining sterility (Tabutin 1982). Moreover, for Chad, which also had ethnic groups suffering from infertility (Retel-Laurentin 1974), declining sterility is likely a contributing factor in the increase in fertility. Although Cameroon is not one of the laggard countries, it is interesting to note that the Cameroon Fertility Survey in 1978 found that the proportions of women who were childless were over 20 per cent in the 50–54 age group, but were only 10–15 per cent in the 25–39 age group (Santow and Bioumla 1984). In the northern part of

Cameroon, which is geographically adjacent to the most populous regions of Chad, primary sterility among women aged 50–54 was higher than the national average.

The duration of fertility increases after the early 1950s was typically quite substantial. In Chad, fertility increased for 45 years; and in the DRC, fertility increased slowly for 35 years. In Equatorial Guinea and Niger, modest increases lasted for 30 years; and in Mali, the TFR rose to above seven in 15 years, and then held steady for another 20 years. The increasing trend in The Gambia lasted for 25 years. In Somalia, the TFR was stable at 7.25 over a 20-year period starting in the 1950s, then declined slightly, and subsequently increased over a 20-year period.

Declines in fertility following the peak have varied in their speed. Here, we use the duration from peak fertility to a level representing a decline of 10 per cent or more from that peak as an inverse measure of the initial pace of fertility decline (for the DRC and Niger, we use the projected quinquennium at which the 10 per cent decline will be realised). In Chad and Somalia, this decline occurred in 15 years; and in the DRC and Mali, the duration of the decline is estimated at 20 years. Equatorial Guinea took 25 years to achieve a 10 per cent fertility decline. Very slow declines to this level from the peak are observed in The Gambia, where the decline took 35 years; and in Niger, where the decline is estimated to take 40 years.

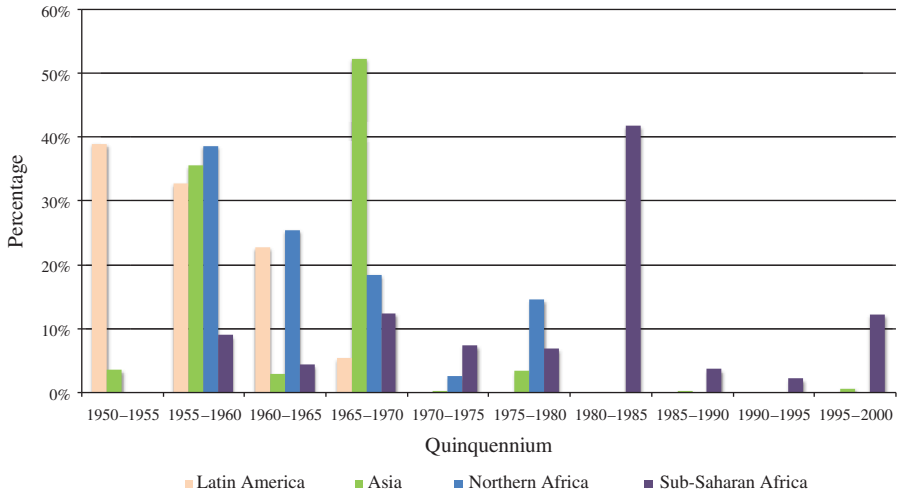
On average, then, the duration of a 10 per cent decline in fertility from its peak was just over 24 years for these countries. For the remaining countries in sub-Saharan Africa, the corresponding unweighted mean duration was just under 19 years. As we shall see below, the pace of fertility decline in the region following its onset was slow compared to elsewhere in the developing world.

A comparison of the fertility of these laggard countries with that of all developing countries shows that the downturn in fertility took place much sooner in the latter (beginning in the early 1970s) than in the former (beginning anywhere from the late 1970s to the early 2000s, with the median being in the early 1990s, or 20 years following the downturn in all developing countries). Likewise, the fertility decline in sub-Saharan Africa did not start until the 1980s; and it has been much slower than the fertility decline elsewhere in the developing world (Shapiro and Hinde 2017). Within sub-Saharan Africa, Middle Africa is the laggard region. Prior to the early 1980s, fertility in Middle Africa was below that of sub-Saharan Africa, largely as a consequence of infertility in the DRC and elsewhere in the region (Retel-Laurentin 1974; Lesthaeghe 1984; Shapiro et al. 2017). But after that point, fertility in Middle Africa increased continuously for a decade, reaching almost the peak of just under 6.8 that was realised in the entire region. The fertility decline did not begin in Middle Africa until the early 1990s.

3 The timing of peak fertility

In this section, we examine the timing of the onset of the fertility transition, as demarcated in each country by the period following the realisation of its peak level of fertility, and we compare the timing of peak fertility in the four different regions

Figure 2:
Quinquennium of peak fertility, by region

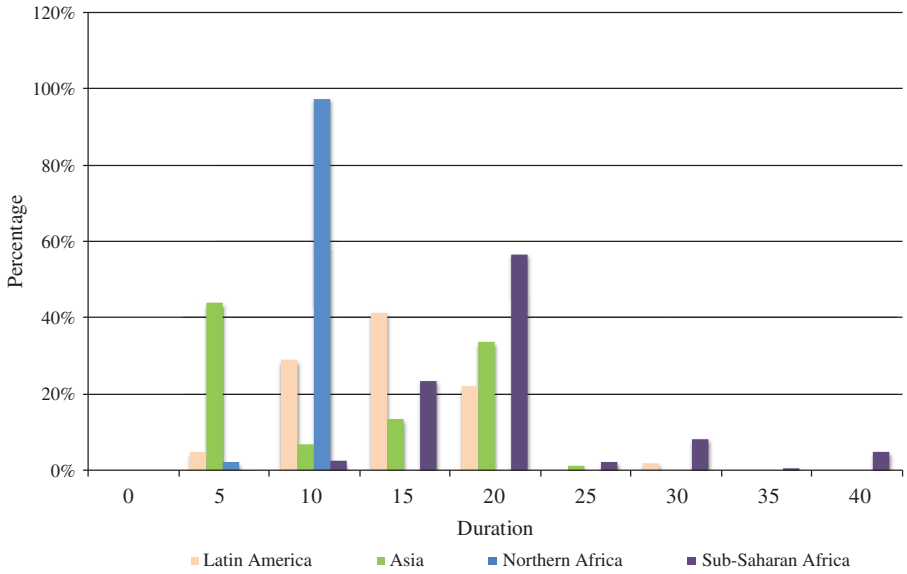


consisting of developing countries. Calculations are weighted with the populations of each country. In addition, we examine the duration required for each country to reach a level of total fertility that is at least 10 per cent below its peak fertility level, as an inverse indicator of the pace of fertility decline once it has begun. We also compare the regions on this measure.

Figure 2 shows the percentage frequency distributions of the quinquennium in which peak total fertility was realised for the populations in the countries in each of the four regions. It is clear that, as expected, sub-Saharan Africa was the laggard among these regions in terms of the timing of the initiation of the fertility decline; with the fertility decline starting earlier in Latin America, Northern Africa, and Asia. The median quinquennium of peak fertility was 1955–1960 for Latin America, compared to 1960–1965 for Northern Africa, 1965–1970 for Asia, and 1980–1985 for sub-Saharan Africa.

For the vast bulk of the population of Latin America, peak fertility was reached during the period from 1950 to 1965. In Northern Africa, peak fertility occurred in 1955–1970; while in Asia, peak fertility was realised in countries with more than a third of the region's population during the late 1950s, and in countries with more than half of the region's population in the late 1960s. In contrast, in sub-Saharan Africa, peak fertility was not reached for more than 40 per cent of the region's population until 1980–1985. Indeed, whereas in the other three regions, peak fertility had been realised by 1980; in sub-Saharan Africa, 60 per cent of the population experienced peak fertility in 1980 or later. Hence, based on the median quinquennia at which peak fertility was reached, we can state that fertility decline at the regional

Figure 3:
Duration until 10% decline from peak fertility, by region



level began in the early 1960s in Latin America, in the late 1960s in Northern Africa, in the early 1970s in Asia, and in the late 1980s in sub-Saharan Africa.

The weighted percentage distributions of the duration between hitting the peak fertility level and reaching a level of fertility that is at least 10 per cent below the peak are shown in Figure 3.[1] In sub-Saharan Africa, fertility has declined much more slowly than it has elsewhere: the average duration until fertility has fallen by at least 10 per cent from its peak level is 20.6 years in sub-Saharan Africa, compared to 14.5 years in Latin America, 12.1 years in Asia, and 14.9 years in Northern Africa.

When that duration is 10 years or less, the average annual decline in fertility is one per cent (or more). When we look at the countries with comparatively rapid initial levels of fertility decline, we see that less than three per cent of the population of the 50 countries in sub-Saharan Africa (primarily from Malawi, Congo, and Namibia) fall into this group. By comparison, while less than three per cent of the population in Northern Africa (Libya) also experienced rapid fertility decline, more than 50 per cent of the population in Asia and 34 per cent of the population in Latin America had rapid initial levels of fertility decline. Conversely, while it took

[1] The data reported in both Figures 2 and 3 and in the text use population weights from the year corresponding to the onset of fertility decline in each region – i.e., from 1960 for Latin America, 1965 for Northern Africa, 1970 for Asia, and 1985 for sub-Saharan Africa. As a robustness check, we also did calculations using 1980 as the base year for all four regions. The results were very similar.

25 years or more for fertility to decline from its peak by 10 per cent for only two per cent or less of the population in Latin America, Asia, and North Africa; this was the case for almost 17 per cent of the population in sub-Saharan Africa.

4 Factors influencing fertility

In this section, we review a variety of socio-economic and demographic factors that have been linked to fertility and fertility transition in sub-Saharan Africa and elsewhere in the developing world. Garenne (2018) has shown that contraceptive use is pertinent to the pace of fertility decline in the region, and Shapiro (2012) has emphasised that women's education is also a key socio-economic factor influencing fertility. Rutstein (2000) has documented that mortality is declining in sub-Saharan Africa, and Shapiro and Tenikue (2017) have shown that declining infant and child mortality and increasing women's education are important factors contributing to fertility decline in the region. Bongaarts and Casterline (2013) and Casterline and Agyei-Mensah (2017) have stressed the influence on fertility of fertility desires, as reflected in the ideal number of children. Sub-Saharan Africa is characterised by particularly strong fertility desires.

Shapiro (2019) has shown that after controlling for women's education and numerous other factors, Muslim women tend to have a higher ideal number of children than non-Muslim women. This observation reflects stronger preferences for children among Muslim than among non-Muslim women, and is expected to be associated with slower fertility declines.[2] Antoine (2006) has documented changes in marital status in multiple African capital cities; and more broadly, Shapiro and Gebreselassie (2014) have documented the contribution of reduced nuptiality in the region to declining fertility. With respect to economic conditions, historical evidence shows that economic growth and development are associated with declining fertility. At the same time, however, Eloundou-Enyegue et al. (2000) and Shapiro (2015) have provided evidence indicating that adverse economic conditions in sub-Saharan Africa have in some cases appeared to contribute to more rapid fertility decline. In the context of the Easterlin framework for fertility analysis (Easterlin 1975; Easterlin and Crimmins 1985), these various factors constitute both background factors and proximate determinants.

[2] For example, consider the case of Nigeria, a country with substantial numbers of Muslims and non-Muslims. In the Nigeria 2013 DHS, regression analysis shows that after controlling for women's education, marital status, and numerous other factors linked to the ideal number of children, Muslim women have a significantly higher ideal number of children than their non-Muslim counterparts, with the differential being well over one child.

Table 2 shows the values of variables representing these factors for the seven laggard countries, as of the latest DHS in each country.[3] It also shows the averages for these variables from a group of 34 other countries in the region, allowing for a comparison of the laggards with a substantial number of other sub-Saharan countries, all of which are farther along in their fertility transitions.[4] In addition, the estimated TFRs from the United Nations (2017) for 2010–2015 are included.

There is considerable variation among the laggard countries in each of the variables in the table, except for those pertaining to modern contraceptive use, all of which are low. On average, modern contraceptive use is only about a quarter to a third as high in the laggard countries as it is in the group of comparison countries. Education is especially low in Niger, Mali, Chad, and Equatorial Guinea; while it is high in the DRC. Compared to the averages for the non-laggard countries, the mean number of years of schooling is higher, and the percentage with no schooling is lower in the DRC. However, the percentage with secondary education is substantially lower in the DRC than the average for the countries that are farther advanced in their fertility transitions. Moreover, as has been shown elsewhere (Shapiro 2012; Shapiro and Tambashe 2017), in the DRC and in other countries in the region, it is at the secondary schooling level that distinct declines in fertility as schooling increases can be observed.

Mortality is highest in Somalia, Chad, Equatorial Guinea, and Niger; and lowest by far in The Gambia. Average mortality in the comparison countries is lower than that in all of the laggard countries except The Gambia.

The average ideal number of children is around six children for four of the six countries for which this variable is available. In the DRC and Mali, this number is exceeded by actual fertility; while in both Equatorial Guinea and The Gambia, the mean ideal number of children is greater than the TFR. Chad and Niger are the outliers here, with exceptionally high mean ideal numbers of children. The mean ideal number of children of 4.5 found among the comparison countries is substantially lower than the corresponding means for each of the laggard countries.

In five of the seven countries, 90 per cent or more of the population is Muslim; and almost two-thirds of women in Chad are Muslim. Only the DRC has almost no Muslim population. In the comparison countries, not quite 30 per cent of the population is Muslim, on average.

In Niger and Mali, 95 per cent or more of women aged 15–49 years are in a union, compared to about 75 per cent of women in Chad and Equatorial Guinea, and about 65 per cent of women in The Gambia and the DRC. All of these figures exceed the mean of 61 per cent for the comparison countries.

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[3] As Somalia has never had a DHS, much of the data for Somalia are not available. The demographic measures that are available come from the United Nations (2017) estimates, and the source for the percentage Muslim is the Central Intelligence Agency (CIA) *World Factbook* (2017), which indicates that Islam is the official religion of Somalia.

[4] The comparison group of 34 countries excludes several very small countries in the region.

Table 2:
Socio-economic and demographic factors influencing fertility, latest Demographic and Health Surveys

Factor	Chad	Democratic Republic of the Congo	Equatorial Guinea	The Gambia	Mali	Niger	Somalia	Averages[a]	
								Laggards	Others
Mean years of schooling	2.3	6.1	2.6	4.7	2.2	1.4	NA	3.2	5.6
Percentage with no school	63	18	67	47	70	80	NA	58	28
Percentage with secondary+	15	48	19	40	17	9	NA	25	73
Infant mortality	72	58	67	34	56	51	79	60	52
Under-five mortality	133	104	123	54	95	127	131	110	82
Mean ideal number of children	8.2	6.1	5.8	6.0	5.9	9.2	NA	6.9	4.5
Percentage Muslim	65	2	90	97	92	80	100	75	28
GDP/head	$2,048	$726	$34,363	$1,599	$1,805	$863	NA	$1,174[b]	$3,999
GDP/head growth[c]	13%	13%	89%	7%	7%	3%	NA	9%[d]	13%
Percentage in union	75	64	74	66	85	89	NA	76	61
Median age at first marriage	16.1	18.7	17.0	18.6	18.0	15.7	NA	17.4	19.8
Percentage using modern contraception									
All women	5	8	5	8	10	12	NA	8	23
Women in union	5	8	5	8	10	12	NA	8	32
TFR in 2010–2015	6.3	6.4	5.0	5.6	6.4	7.4	6.6	6.2	4.6

Notes: [a]For the seven laggards and for 34 other countries in sub-Saharan Africa. In total, these 41 countries represented nearly 94 per cent of the population of sub-Saharan Africa in 2015. In some of the other countries, no DHS has been conducted; hence, for these countries, data are missing for the calculation of most averages. [b]The average for the laggards does not include Equatorial Guinea. [c]During the five years preceding the survey's measurement of fertility. [d]The average figure for the laggards excludes Equatorial Guinea, which experienced substantial growth.
Source: Analyses of Demographic and Health Survey country data files, DHS Statcompiler, https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD?order=wbapi_data_valu [accessed 14 April 2020], United Nations (2017). The sample consists of women aged 15–49 years in each country, except for age at first marriage (ages 25–49 years) and contraceptive use among women in a union. NA indicates that data are not available.

The median age at first marriage among women aged 25 years and older is only about 16 years in Niger and Chad and 17 years in Equatorial Guinea, compared to 18–19 years in the DRC, The Gambia, and Mali. And the mean of the median age at first marriage for the laggards is almost 2.5 years lower than that for the comparison group, which is just under age 20 years.

GDP per head, based on data from the World Bank, ranges from a little over $700 to a little more than $2,000 for five of the six countries with data available. The mean for these countries is just under $1,200. Equatorial Guinea is an anomaly; it has substantial income from petroleum which, in conjunction with its small population, results in a very high GDP per head. But since the income from oil is controlled by the president and does not benefit the general population, the country's very high GDP per head has nothing to do with the economic well-being of the population (CIA 2018).

The average GDP of the five countries with meaningful data on GDP per head is not quite a third of that of the comparison countries. Looking at the growth in GDP per head during the five years prior to the measurement of fertility in the DHSs, we see that it was positive but modest in the laggard countries, ranging from three to 13 per cent, and averaging almost nine per cent.[5] By comparison, among the other countries, recent growth in GDP per head has been more varied, with a few countries showing declines. Overall, however, the average growth rate is 13 per cent.

In sum, the laggard countries are distinguished in numerous important ways from the other countries in sub-Saharan Africa that are more advanced in the fertility transition. With the notable exception of the DRC, they have distinctly lower educational attainment and substantially higher proportions Muslim than the comparison countries. These countries also have higher ideal numbers of children, lower GDP per head and slower recent growth in this measure, somewhat higher infant and child mortality, higher proportions in a union, an earlier age at first union, and lower use of modern contraception. All of these differences help to explain the higher fertility in the laggard countries. Next, we consider the prospects for fertility decline in each of these countries in view of their characteristics, as shown in Table 2.

5 Prospects for fertility decline

We begin with the two countries that have not yet achieved a 10 per cent decline from their peak fertility level. As we noted in the preceding section, the Democratic Republic of the Congo has comparatively high women's educational attainment, which would normally be expected to facilitate fertility decline. However, as Smith-Greenaway (2015) has shown, there is only a weak correlation between education

[5] A DHS measures fertility during the three years prior to the survey. Hence, this measure looks at the growth in GDP per head for the period from three to eight years prior to the DHS.

and literacy in much of sub-Saharan Africa. She has found that in the DRC, fewer than half of women with six years of schooling have full reading skills (Fig. 1b, p. 1022). Because of the economic difficulties the DRC has experienced over much of the past 30 years, public funding for education has been low (Shapiro et al. 2017). This could mean that problems with school quality limit the effects on fertility of school quantity.

Furthermore, a distinguishing characteristic of Congolese women compared to their well-educated counterparts in other countries is that they have a high ideal number of children (Romaniuk 2011). More generally, conditional on their educational attainment, Congolese women tend to have a high ideal number of children (Shapiro 2018). Guengant et al. (2014), in their analysis of the DRC, describe the "greatness syndrome"; whereby the country's vast area, mineral wealth, and other resources are seen by both elites and much of the general population as making fertility control unnecessary. Thus, all that is needed, in their view, is better management of existing resources. This syndrome – which is similar to the perceived effects of abundant resources in a vast country found to contribute to the very high fertility of French Canadians in the 17th and 18th centuries (Charbonneau et al. 2000) – may well be a contributing factor in the DRC's high levels of ideal number of children; and, hence, in the country's high fertility.

Absent a weakening of this greatness syndrome, the best option for ensuring continued and accelerated fertility decline in the DRC is – in addition to continued increases in women's education (especially at the secondary level and above) and continued reductions in infant and child mortality – economic development that generates demand in the labour market for individuals with useful skills (Lachaud 1994 provides a short but still-relevant critique of education and training in Africa). Since the acquisition of skills requires human capital investments, this shift would contribute to fertility reduction as parents increasingly opt for "quality" in the quality-quantity trade-off.

Niger is a very different case. It has the highest fertility in the world at present. More than 80 per cent of women of reproductive age in Niger have never been to school, and only nine per cent have secondary or higher education. Women in Niger, as in other Muslim countries, share the slightly higher fertility preferences found among Muslims, other things being equal (Shapiro 2018). Indeed, the mean ideal number of children is extraordinarily high in Niger, at 9.2 per woman. With such high actual fertility and an even higher ideal number of children, in conjunction with a resource-poor environment in which opportunities for out-migration in hard times have become considerably more limited, Niger appears to be a Malthusian disaster waiting to happen.[6] Casterline and Agyei-Mensah (2017) have found that,

[6] Although demographers have been writing in this vein about the Sahel region for 50 years, the threatened disaster has yet to materialise. The ability of the Sahel to accommodate very rapid population growth during the past 20–30 years without widespread increases in malnutrition or major famine is remarkable. For a recent discussion of these issues, see Potts et al. (2013).

uniquely even among the countries of West and Middle Africa, in Niger, there is almost no desire to stop childbearing even among women with six children.

Chad has a profile that is similar to (but is less extreme than) that of Niger: the country has low education, high infant mortality, a very high ideal number of children, and a very low age at entry to marriage. Despite the absence of conditions favourable to reduced fertility, Chad has seen relatively rapid declines in its TFR in the last two quinquennia. In the last estimate, fertility in Chad was 1.1 children below its peak, but was still high at 6.3. Given the country's profile, it remains to be seen if the recent rapid declines will continue.

Equatorial Guinea has low education and comparatively high mortality, is 90 per cent Muslim, is tied for the lowest rate of use of modern contraception, and has an ideal number of children in excess of actual fertility. All of these factors serve to promote high fertility. Despite these conditions, the estimated recent fertility declines in Equatorial Guinea have been increasing in magnitude. While the UN projections foresee continued more-than-trivial fertility declines in this country, the underlying factors are not propitious.

Compared to the other laggard countries, The Gambia is intermediate with respect to education, has the lowest mortality, and has a comparatively high age at first union and a low percentage of women in a union. These factors are favourable to ongoing fertility decline. But on the other side of the ledger, the population is almost entirely Muslim; and, most notably, the country has a mean ideal number of children in excess of its TFR. In line with the UN projections generally for the countries of sub-Saharan Africa, continued declines in fertility are anticipated for The Gambia in the coming years.

Mali has low education and a high percentage of women in a union, and is more than 90 per cent Muslim. These fertility-promoting factors are offset somewhat by a moderately high mean age at first union and the fact that the TFR in the country exceeds the mean ideal number of children by half a child. This latter point suggests that there may be opportunities for effective family planning to assist women in reaching, but not exceeding, their fertility goals.[7]

Due to Somalia's unstable political situation, a Demographic and Health Survey has never been conducted in the country. Hence, only very limited information about this country is available. The existing data show that compared to the other laggard countries, Somalia has high mortality, a very high percentage Muslim, and the second-highest TFR. These factors are all conducive to slow fertility decline; but again, the UN projections indicate that the country is experiencing an ongoing decline that is not slow.

[7] The TFR being in excess of the mean ideal number of children does not guarantee that parents seek to reduce the number of births, since in the face of traditionally high infant and child mortality, realised fertility may include births that constitute insurance or replacement motives for childbearing. However, it seems likely that in this situation, some women would wish to limit their fertility.

6 Concluding remarks

This paper has examined fertility trends in the seven countries that lag behind the rest of the world in undergoing the fertility transition. We have also discussed the social, economic, and cultural characteristics of these countries. We might ask whether there is any single characteristic that separates these seven countries from the rest of the countries in sub-Saharan Africa. The analysis in the preceding section suggests that this is not the case. As we have seen, fertility is associated with many different factors that, when taken together, can be viewed as a multi-dimensional space within which each country occupies a unique position. A certain zone of this space is associated with a resistance to fertility decline. Countries in this zone tend to have fertility-promoting values on most – though not necessarily all – of the factors we have considered. Over the past five decades, most of the countries of the world have moved out of this zone. The laggards are the last countries to do so, and one or two of them are still confined within it.

In the end, however, the laggards will shift their position away from the high fertility zone, and join the other countries of the world in the global fertility transition. But the continuing high fertility of the laggards will contribute for some time to come to the ongoing status of sub-Saharan Africa as the lone remaining high-fertility region in the world. Moreover, because fertility in the laggard countries is so high, further delays in the onset and progress of the fertility transition have the potential to greatly augment population growth in these countries. To take one example, Niger currently has a population of around 23 million. In the next 50 years, mainly depending on how quickly fertility declines, the UN estimates its population could be anywhere between around 80 and 130 million; and the corresponding range for the DRC is 200–350 million people (United Nations 2019).[8] The rate at which the fertility transition in these laggard countries progresses will, therefore, have a substantial impact on future population growth in sub-Saharan Africa, and will affect the size of the challenge of improving human well-being in this region.

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[8] These ranges are based on 80 per cent prediction intervals. Although assumptions about mortality and migration play a minor part, the main factor affecting the forecasts is the future fertility trend.

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Projecting future births with fertility differentials reflecting women's educational and migrant characteristics

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Abstract

Building on the well-established knowledge on fertility differentials by education and nativity/migration status, we employ microsimulation modelling to demonstrate the effect of accounting for such differences in population projections. We consider fertility differentials by educational attainment, enrolment in full-time education, region of birth, age at immigration, and duration of stay in the host country, which we introduce step-wise into the microsimulation model for the EU28. Results on projected TFRs and births by 2060 illustrate the importance of accounting for several sources of population heterogeneity. In the context of future educational expansion, modelling education differentials for students and for women with completed education is needed to capture the postponement effect of education on childbearing. Future migration assumptions that include migrant fertility differentials lead to widely varying projected numbers of future births. At fixed fertility differentials and a fixed composition of immigrant flows, the net effect of immigrant fertility on the overall TFR in the EU28 is projected to increase from the estimated 0.12 in 2015–2019 to 0.17 in 2055–59 in the scenario with baseline migration, and to 0.25 in 2055–59 in the scenario with doubled migration.

Keywords: population projection; microsimulation; fertility; education; immigrants

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1 Introduction

Past research has established that fertility rates among women differ by their level of education (e.g., Rindfuss and Bumpass 1980; Kravdal 2002; Lutz and Skirbekk 2014) and by their country of birth (e.g., Sobotka 2008; Kulu et al. 2019). How important is it to take these differentials into account when projecting the population of the EU? To what extent does using different approaches to modelling fertility affect the projected number of births? Both the expansion of education and the immigration of foreign nationals into the EU are trends that are likely to continue in the future, and that will play a role in shaping the population of the EU.

We argue that the multi-dimensional modelling of fertility is needed to capture the implications of differences in fertility across socio-economic groups, as the EU population is becoming increasingly diverse as a result of higher and more diversified migration flows in many EU countries in recent decades. When projecting population, it is important to account for immigration from third countries with generally higher fertility levels than the host EU countries, because it impacts the composition of the female population of reproductive age (by nativity, and also by education) – and, consequently, the number and the structure of births, as well as the size and the composition of the population. As differences in fertility between the native-born population and various groups of immigrants are partly associated with educational attainment (e.g., Roig Vila and Castro-Martín 2007), it is important to capture both dimensions simultaneously. Building on the well-established knowledge about differentials in fertility by education and migration status, we employ microsimulation modelling to demonstrate the effect of accounting for such differences in population projections. We focus on differences in the projected total fertility rate (TFR) and in the number of births and their composition. We present several scenarios that differ in how they model fertility and in the migration assumptions they use. As this work has been developed within the CEPAM project,[1] it focuses on EU28 countries.

Conventionally, multistate population projection methods (Rogers 1980, 1986; Schoen 1988) are used to take into account population diversity beyond the standard components of age and sex. The dimensions that are usually included in multistate projections influence population dynamics, and are associated with differences in fertility, mortality, and the propensity to migrate, such as educational attainment, which is closely linked to all components of population change (Lutz and Goujon 2001; Lutz et al. 2014). Among the other dimensions that are commonly included in such projections are place of birth (Rogers et al. 1999), religion (Goujon et al. 2007; Stonawski et al. 2015), ethnicity (Rees 2002; Raymer et al. 2018), and race (Colby and Ortman 2015). Multistate population projections usually include one, or at most two dimensions in addition to age and sex because adding three or more dimensions

[1] The Centre for Expertise on Population and Migration (CEPAM) is a joint research project between IIASA and the Joint Research Centre of the European Commission that studies the future changes in EU populations under various alternative migration scenarios.

at the same time increases the complexity of this type of model to the point where it is difficult to handle any additional state. In a full multistate model, each additional state multiplies the set of transitions between the states. Data limitations also play an important role, particularly when the projection is for a group of countries with differing levels of data quality.

In contrast, microsimulation modelling offers a flexible way of taking into account a larger number of characteristics simultaneously. It is easier to handle a large number of parameters, because adding a dimension does not require multiplying all of the others. Adding a dimension simply involves adding a single column in the database. Among the advantages of microsimulation models are that they can provide richer outputs, and they can be used to build individual-level determinants of events. Thus, such models can provide better results when the number of dimensions included is relatively large, and when handling interactions between multiple variables (van Imhoff and Post 1998). The CEPAM-mic microsimulation model captures both the educational and the migrant characteristics of individuals, and its dimensions include age, sex, educational attainment, region of origin, duration of stay in the host country, and several others detailed in section 3.2. Importantly, microsimulation facilitates the appropriate modelling of period fertility because it enables us to include (rather than to adjust for) tempo effects in fertility that arise due to educational enrolment and the interplay between the migration process and childbearing.

This paper is structured as follows. As a backdrop to the modelling of fertility, we summarise the most enduring findings on fertility differentials by the educational and the migrant characteristics of women. In the data and methods section, we explain our general approach of contrasting the conventional multistate method with the microsimulation, while specifically focusing on the approaches to and the challenges involved in modelling fertility differentials. We then introduce the projection scenarios. In the data section, we also describe the CEPAM-mic microsimulation model, including its modules, its baseline population estimates, and its parameters. In a dedicated subsection, we present in detail the fertility module, including the data and estimation procedures for the parameters, and the results obtained using logit regression on Labour Force Survey data. In the results section, we focus on the compositional effects of education and migration on overall TFRs, and the number of births in the EU28 countries estimated under different projection scenarios. The scenarios differ in terms of the fertility modelling approaches and the migration assumptions they use to illustrate the compositional effects, and in the sensitivity of the models to the assumed migration volumes. We conclude with reflections on the relevance and the limitations of our exercise.

2 Background

Across social groups, fertility levels, the timing of parenthood, and fertility ideals can vary substantially (e.g., Berrington and Pattaro 2014). Among the

socio-economic variables that influence fertility, the educational attainment of women stands out as having a strong and consistent negative relationship with fertility (Rindfuss and Bumpass 1980; Jeejebhoy 1995; Kravdal 2002; Bongaarts 2003; Lutz and Skirbekk 2014). Compared to their less educated counterparts, educated women tend to have fewer children later in life, and are more likely to be childless. Educational expansion is a major driver of the postponement of parenthood, because in modern, post-industrial societies, schooling extends well into reproductive ages (Neels et al. 2017; Ní Bhrolcháin and Beaujouan 2012), and family formation is often normatively conditioned on the completion of education (Blossfeld and Huinink 1991; Mortimer et al. 2005). Analyses of series of completed cohort fertility rates have shown that education differentials tend to decline as the overall fertility rate decreases, and that they tend to be more pronounced among older than younger cohorts. Such differentials are smaller in institutional settings that mitigate the high opportunity costs of childbearing with policies that promote work-family balance, gender equity, and affordable childcare (Kravdal and Rindfuss 2008; Wood et al. 2014). Cohort differentials in fertility by education have diminished in some Western and Northern European countries (van Bavel 2014; Jalovaara et al. 2019), but strong gradients persist, particularly in Eastern Europe (Basten et al. 2014; Wood et al. 2014; Brzozowska 2016).

International migration is another important factor underlying the fertility differences in low-fertility countries. It has become particularly important in the EU members states that host sizeable foreign-born populations, and that are seeing sustained immigration from third countries. In these states, women of reproductive age have become increasingly diverse in terms of their ethnicity, region of origin, religion, and other relevant ethno-cultural characteristics. This diversity could have lasting long-term effects on demographic trends and population composition (Coleman 2006). Across the EU countries, growing shares of births are to mothers of immigrant origin. In some EU member states (MS), the percentage of live births to immigrant mothers has exceeded 25–30% over the past decade.[2] While births to foreign-born mothers have increased, the net effect on overall TFR remains limited, though not negligible (Sobotka 2008).

As the heterogeneity of European populations is growing, immigrants and their descendants could shape demographic trends to a greater extent in the future than they do today, assuming the current patterns of childbearing and of immigration persist. While immigrants tend to have higher fertility than the native-born population, fertility rates vary greatly among immigrant women depending on their country of origin (Andersson 2004; Dubuc 2012; Mussino and Strozza 2012; Sobotka 2008). In general, women from low-fertility countries tend to have low fertility in the host country, and often have even lower fertility than native-born women; whereas women from high-fertility countries tend to have high fertility in the host country (Mussino and Strozza 2012; Persson and Hoem 2014; Kulu et al. 2017). However,

[2] See EUROSTAT table: demo_facbc

the country of origin may be a less important explanatory variable than the selection of immigrants in terms of their individual characteristics (Andersson 2004; Kulu 2005). Women's educational attainment, as well as their reasons for migration, likely influence their fertility.

A growing number of studies have highlighted that the country of origin, the age at arrival, and the duration of stay in the host country affect the underlying differences in fertility levels between immigrants. There is strong evidence that the fertility levels of migrants are converging with those of the native-born population. However, for some specific immigrant groups within specific country contexts, the fertility levels of the descendants remain well above the fertility levels of the native-born population (Dubuc 2012; Kulu et al. 2019). Convergence towards mainstream fertility levels is observed across different generations of immigrants, with first-generation immigrants (G1) having the highest fertility rates, those who arrived as children (G1.5) having lower fertility rates, and the descendants of immigrants (G2) having fertility rates that are the most similar to those of native-born women (Kulu et al. 2017; Krapf and Wolf 2016). This pattern of intergenerational convergence has been interpreted through the lens of the adaptation hypothesis, which assumes that the context of the host country greatly influences an individual's fertility desires, plans, and behaviours. In contrast, the socialisation hypothesis posits that each individual's preferences are relatively stable over his/her lifetime, and depend on the socialisation context. Thus, according to this hypothesis, an immigrant's age at arrival, and whether s/he was socialised in a high- or a low-fertility context, will influence his/her observed fertility. Dubuc (2012) found that the convergence, which is prominent for populations originating from high-fertility countries, reflects in part decreasing fertility in sending countries, and in part intergenerational adaptation to the UK mainstream.

The adaptation hypothesis argues that immigrants' intentions and behaviours change in response to the host country context. Looking at Sub-Saharan African immigrants in France, Afulani and Asunka (2015) found more evidence for the adaptation hypothesis than for the socialisation hypothesis. They also showed that the adaptation hypothesis accounts for the immigrants' actual fertility, rather than just their fertility ideals.

Fertility is closely intertwined with the migration process. The disruption hypothesis posits that childbearing is likely to be depressed around the time of migration, or may not have started prior to immigration. Consequently, fertility often peaks in the first years after arrival in the host country, resulting in a tempo effect that influences period measurements of immigrant fertility (Toulemon 2004; Mussino and Strozza 2012; Robarts et al. 2015). Persson and Hoem (2014) found for Sweden that the disruption hypothesis is particularly relevant for non-EU immigrants from low-income countries, while non-EU immigrants from high-income countries tend to delay childbearing until several years after migration. Robarts et al. (2015) confirmed both findings for UK immigrants, and showed that (a) the fertility rates of immigrant women from low-income countries peak within four years

after immigration; and that (b) women from high-income countries tend to delay childbearing and have lower fertility rates.

The hypothesis of interrelated life events explains the high fertility upon arrival in the host country in the context of the family formation process. According to this hypothesis, immigrants who arrive on family reunification grounds exhibit high fertility in the years immediately after arrival, because for them, childbearing is directly linked to immigration (Castro Martin and Rosero-Bixby 2011; Mussino and Strozza 2012; Robarts et al. 2015). In contrast, women who arrive in the country to work or to study are expected to delay childbearing and have lower fertility. A decision to have a child shortly after arriving in the host country can also be linked to poor employment prospects (Kulu and Milewski 2007). The interrelation between the opportunities in different life domains influences a couple's fertility decisions.

As immigrants arriving on various grounds can also differ in their educational characteristics, education becomes an important confounding variable to account for when examining fertility differentials. Dubuc (2017) found that educational differences between successive generations of immigrant women and their daughters indeed explained in part the convergence in fertility towards the mainstream.

Thus, making assumptions about the future fertility of immigrant women is challenging, because we would have to account for (a) ongoing fertility transitions in developing countries and (b) educational expansion, and (c) make assumptions about the composition of future migration flows by country of origin. Explicit and implicit migration policies can affect the future composition of immigrants to the EU in terms of their grounds for immigration, their countries of origin (e.g., restrictions on family reunification that favour already established diaspora), their educational levels (e.g., selective policies favouring highly educated immigrants with skills needed in the future labour market), or their gender (e.g., the demand for care workers in ageing societies). Due to selection, immigrants may exhibit very different childbearing patterns than those of the mainstream in the country of origin, as they may be arriving from high-/low-fertility regions, and they could be selected in terms of their educational characteristics.

To conclude, existing evidence of fertility differentials between immigrants and the native-born population, as well as across various immigrant groups, highlights the importance of accounting for three main variables associated with such differentials: the country of origin, the age at arrival in the host country, and the duration of stay. To illustrate the effect of modelling with different sets of differentials – while easing the interpretation of the results – we keep the composition of immigrants,[3] as well as fertility differentials among the migrant groups, constant for the whole

[3] The composition of non-EU immigrants is estimated using the EU Labour Force Survey, adjusted using data from the 2011 census on country of origin and year of arrival. This process results in 39% of these immigrants coming from Asia; 35% coming from Africa or MENA; 11% coming from Latin America; and 15% coming from a non-EU European country, North America, or Australia.

projection period. As it is well-documented that enrolment in education has a postponement effect on fertility, we argue in the next section that enrolment in education should be accounted for alongside educational gradients in fertility.

3 Data and methods

3.1 Approach and scenarios

Our aim is to explore the impact of modelling fertility differentials by education from a life course perspective rather than relying on the conventional approach used in the multistate population projections, and to examine the effects of differentials between the native-born population and various groups of immigrants on projection results. To identify such differences, we build our scenarios around assumptions regarding future overall fertility (TFR)[4] and educational gradients in fertility rates drawn from existing multistate population projections by education (Lutz et al. 2014 and 2018). Before we describe the scenarios and their underlying assumptions, we outline the methodological challenges we face in modelling fertility differentials.

In a conventional multistate approach, educational differentials in fertility are modelled as if women at a given age had completed the highest level of education they would ever achieve. This approach is problematic in high-income countries, in which a large share of a given female cohort is studying at the post-secondary level. For example, at ages 20–24, most women will have completed upper secondary education, but a large proportion of them will be enrolled in post-secondary education. In Lutz et al. (2014 and 2018), educational differentials in fertility are modelled with fertility rates that are derived from the cohort fertility rates of women who have not studied beyond the upper secondary level. Education is strongly associated with fertility timing, and in most economically advanced societies, the birth of the first child is closely linked to other life transitions, with the completion of full-time education being a strong normative determinant (Mortimer et al. 2005). Consequently, the fertility rates of women in full-time education are much lower than they are among women who have completed their education.

This methodological issue becomes highly relevant when the modelling of fertility described above is coupled with the assumption that educational expansion is continuing. In the global educational trend (GET) scenario, it is assumed that an ever-larger share of women will pursue post-secondary education in each subsequent projected cohort (Barakat and Durham 2014). Thus, the share of students among women of younger reproductive ages increases. In such cases, the conventional modelling of education differentials leads to overestimated fertility rates because the fertility rates of women with levels of completed education are

[4] The assumptions are based on extensive information from experts, and are detailed in Basten et al. (2014). The fertility assumptions in our EDU scenario are drawn from the SSP2 scenario.

applied to women who are still in full-time education. This results in a higher number of projected births to women with lower and upper secondary education. We expect this bias to become increasingly pronounced towards the projection horizon because of the projected educational expansion.

A solution lies in modelling fertility differentials from a life course perspective. Microsimulation models are well-suited to addressing this shortcoming of multistate models, as they simulate the life courses of individuals across multiple life careers. In the CEPAM-mic microsimulation model (detailed in the next section), we go beyond modelling fertility by educational attainment only by introducing a new status – STUDENT – and include fertility differentials between women enrolled in full-time education and women who have completed their education.

The fertility module is set up in a flexible way that allows us to gradually introduce changes to how we model fertility differentials. We have built six scenarios combining three assumptions of fertility and two assumptions of migration (Table 1). Our baseline scenario (EDU) models fertility in the same way as conventional multistate models. We include fertility assumptions (age- and education-specific fertility rates) from the medium scenario of the human capital projections of Lutz et al. (2018). Then, we introduce the differences between women in full-time education (students) and women with completed education. We label this scenario EDU + STUDENT. Next, we add fertility differentials between native-born and immigrant women with different characteristics, and call this scenario EDU + STUDENT + IMMIG. All dimensions of the migration status variable (IMMIG) are detailed in section 3.3.

In order to test the sensitivity of projection results to different possible future immigration flows, we run the same three scenarios with modified levels of immigration to the EU (Table 1). The high migration assumption is derived from the Canadian example – a country with a high immigration rate and a selective migration policy. If the immigration of non-EU nationals increased to the Canadian rate, we would see a doubling of the projected inflow of immigrants from outside of the EU relative to recent trends. The doubling of immigration levels is coupled with greater emigration outflows given the constant emigration rates. Migration between the EU member states is modelled separately using a matrix of bilateral migration rates that are held constant until 2060. Future mortality assumptions are taken from Lutz et al. (2014), and are identical in all scenarios.

Comparisons between the EDU and EDU + STUDENT scenarios allow us to evaluate differences in the projection results that arise due to methodological differences in the modelling of education differentials. The differences between the latter scenarios and the scenario with migrant characteristics illustrate the effect of including population heterogeneity due to migration that is not accounted for in the human capital projections (Lutz et al. 2014, 2018). Our migration assumptions lead to increasing shares of non-EU immigrants in the EU population. We expect to find that the effect of migrant fertility differentials becomes increasingly important towards the projection horizon, and becomes more pronounced in the high immigration scenarios in which we double immigration to illustrate the effect

Table 1:
Overview of scenarios and assumptions

	Scenario assumptions:				
Scenario	**Fertility**	**Immigration from outside the EU**	**Emigration outside the EU**	**Intra-EU migration**	**Mortality**
EDU	Medium (by educational attainment)*	cca 10 million every 5 years	Average rate 2013–2016	Average in and out rates 2009–2016	Medium, by education**
EDU + STUDENT	Medium + differentials for student status				
EDU + STUDENT + IMMIG	Medium + student status + migrant status				
EDU High migration	Medium (by educational attainment)*	cca 20 million every 5 years	Average rate 2013–2016	Average in and out rates 2009–2016	Medium, by education**
EDU + STUDENT High migration	Medium + differentials for student status				
EDU + STUDENT + IMMIG High migration	Medium + student status + migrant status				

Notes: * Lutz et al. (2018)
** Caselli et al. (2014)

of migration. The presented scenarios illustrate what would happen if fertility differentials remained at recent past levels. We also assume that the pace of convergence towards native-born fertility levels with the duration of stay will remain the same as in was the recent past.[5] If future immigrants have lower fertility after arrival, if the convergence occurs more quickly, or if the composition of immigrants changes significantly, the effects of these scenarios on overall fertility and the number of births would be less pronounced than our results indicate.

3.2 CEPAM-mic microsimulation model

CEPAM-mic is a microsimulation projection model covering 28 EU countries that has been developed within the framework of CEPAM project. The model was developed in the Modgen language, and built following the framework for the microsimulation models developed by the Laboratoire de Simulation Démographique (LSD) of the Canadian National Institute of Scientific Research (Bélanger et al. 2019).

[5] For the descendants of immigrant parents (second generation), we assume the same fertility rates at a given educational level as we do for the EU-born population.

In addition to taking into account age, sex, and educational attainment,[6] the baseline population is structured by region of birth,[7] duration or residence (0–4, 5–9, 10+ years), age at migration (0–14, 15+), student status (a student in full-time education, not a student), and several other characteristics not utilised in our analysis, such as language and labour force participation status (Sabourin et al. 2017). The baseline population is derived from the Labour Force Survey, the European Social Survey, and the 2011 census, and it is calibrated to the 2015 base population of CEPAM-mac by age, sex,[8] education, and EU country (Lutz et al. 2018). The method is described in detail in Sabourin et al. (2017).

CEPAM-mic uses exactly the same mortality rates by country, age, sex, and education as those used in the medium scenario of Lutz et al. (2014). These rates were determined after consultation with an expert panel, and are detailed in Caselli et al. (2014). The number of international immigrants from non-EU countries is estimated at about 10 million immigrants every five years, which corresponds to an average of two million immigrants annually during 2013–2016. This inflow is assumed to remain constant in every five-year step of the simulation, but is doubled to 20 million in the scenarios using a high migration variant.

The out-migration rates to non-EU countries are estimated using the average number of out-migrants from 2013 to 2016[9] divided by the average population aged 20–34[10] during the same period, by country. First, the Eurostat-derived out-migration rates are applied to the exposure of the population aged 20–34 in order to obtain the expected number of overall out-migrants in a given year. Age-specific out-migration rates are computed by taking the ratio of out-migrants to the population by age, sex, and country of residence. The age patterns of both immigrants and emigrants follow the standard Rogers-Castro schedule (Rogers and Castro 1981), with the highest levels of migration being observed among the young adults in their twenties.

Out-migration rates in the simulation are recalculated every five years. During the simulation, out-migrants can move within the EU and be assigned a new country of residence, or they can leave the EU and be removed from the simulation. The

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[6] Educational attainment: Low = lower secondary or below (ISCED 0 – 2), Middle = upper secondary (ISCED 3), High = post-secondary (ISCED 4–8); ISCED 2011 definitions.

[7] Regions: own country, EU-15 (old member states), NMS-13 (new member states, since 2004), Europe outside EU-28, North Africa, Other Africa, Near Middle East, East Asia, South and South-East Asia, North America, Oceania, Latin America.

[8] The population composition of the EU countries by age and sex in 2015 corresponds to the that of EUROSTAT (table: demo_pjan).

[9] EUROSTAT table: migr_emi2

[10] The age bracket 20–34 is chosen based on empirical data showing that most out-migrants fall within this age bracket. Using total population in the exposure affects out-migration rates, especially in Southern European countries, due to the older age composition and low migration rates among the older age groups. Using only ages at which the propensity to migrate is highest yields more comparable results.

proportion of out-migrants leaving the EU is estimated from Eurostat tables on emigration according to the region of destination.[11]

The origin-destination matrix for intra-European migration was derived using an update for the period 2009–2016 of Raymer et al.'s (2013) Bayesian estimates of European migration. Country-specific calibration factors are then calculated from a preliminary simulation for the period 2011–2015 in order to obtain the same number of entrances by country as those estimated by Eurostat for the same period. These calibration factors are kept constant for the rest of the projection.

The education module, which is exhaustively described in Marois et al. (2019), determines the highest completed level of education and the age at graduation (for the highest level as well as for intermediary levels) of an individual at birth, considering cohort trends as well as differentials for the most relevant determinants of the individual's education: mother's educational attainment, religion, language, and place of birth (for immigrants who arrived as children). Existing research shows strong intergenerational transmission of education, with mother's education being a particularly salient determinant (Shavit and Blossfeld 1993; Hertz et al. 2008). Empirical data used to estimate education parameters revealed that immigrants who speak a non-European language and who are from some specific regions face disadvantages in access to post-secondary education, even after controlling for mother's education (Marois et al. 2019). Individuals are set as students starting from age five until the age of graduation from the highest completed level of education (up to age 29). Thus, the modelling of education allows us to distinguish, for each individual at each projection step, the highest level of education that the individual will reach during his/her life course, his/her current level of education, and whether or not s/he is still in schooling.

3.3 CEPAM-mic fertility module

The fertility module utilises the age- and education-specific fertility rates of the medium scenario of the human capital projections (Lutz et al. 2018, termed the baseline scenario in this paper), and is built in a flexible way that allows us to implement educational attainment gradients also differentials by student status and migrant background characteristics. These additional parameters are estimated using a logit model that is detailed below. All analyses of Labour Force Survey data (LFS) are executed in STATA 15.1.

We use annual data from the Labour Force Survey 2014–2016[12] that include information on 5,300,110 women of reproductive age (15–49) and 203,113 co-resident children younger than one year old. LFS is the largest household survey

[11] EUROSTAT table: migr_emi3nxt

[12] Annual data from publicly available microdata files for scientific use requested from the EUROSTAT.

that includes a set of harmonised variables for all 28 EU member states. This scope is both an advantage and a disadvantage, because it comes at the price of a reduced level of detail, since some countries provide the data in more aggregated categorisations than others. This lack of detail has also affected some of our variables of interest. For example, the region of birth of the respondent is categorised according to 21 broad, predefined regions, some of which conceal important differences in fertility.

To create our dependent variable, we match the co-resident youngest child aged zero with the mother in the household using the mother identifier.[13] In the LFS dataset, only the age of the youngest child is available in single units of age, while the ages of all other household members are coded in five-year age groups. We use a logit model to estimate the odds ratios of giving birth to a child for women with different educational[14] and migrant characteristics. Our response variable is whether a woman has a child younger than one year old (yes/no).

The logit model, which is expressed in equation (1), aims at estimating differentials for student status (β_9) and migrant status (β_8) net of age and education. Thus, we include in the model interaction variables that control for age-, education-, and country-specific (β_0 to β_7).

$$\begin{aligned}\text{logit}\,(P) = {} & \beta_0 + \beta_1 AGE + \beta_2 EDU + \beta_3 CNTRY + \beta_4\,(AGE * EDU) \\ & + \beta_5\,(AGE * CNTRY) + \beta_6\,(EDU * CNTRY) \\ & + \beta_7\,(AGE * EDU * CNTRY) + \beta_8 IMMIG + \beta_9 STUDENT \qquad (1)\end{aligned}$$

where AGE is age in five-year age groups (15–49); EDU is educational attainment (low, medium, and high); CNTRY is a country (28 EU member states); STUDENT indicates enrolment in full-time education (yes/no, only for ages 15–29); and IMMIG is a composite migration variable constructed using region of birth, age at arrival in the host country, and duration of stay in the host country. We assign the regions of birth of immigrants to six broad regional categories: EU+ (EU28,[15] EFTA[16] countries, Northern America and Australia), Eastern Europe and Turkey,

[13] Variable HHMOTH. Most young children tend to live in the same household as their mother. One potential bias of this matching procedure is that in more complex, multigenerational households, the child may not be matched or wrongly matched to a woman who is not his/her biological mother.

[14] The model uses highest educational attainment at the time of the survey. The results may be subject to reverse causality in terms of education.

[15] EU28 countries as of 2019, including the United Kingdom: AT, BE, BG, CZ, CY, DE, DK, EE, EL, ES, FI, FR, HR, HU, IE, IT, LV, LT, LU, MT, NL, PL, PT, RO, SI, SK, SE, UK.

[16] EFTA (European free trade area) includes the following non-EU countries: Iceland, Liechtenstein, Norway, and Switzerland.

Africa and MENA,[17] Asia (excluding the Middle East), and Latin America.[18] The level of aggregation of the variable in the LFS does not allow us to separate Turkey from Eastern Europe or Northern Africa from sub-Saharan Africa, even though such distinctions would be very useful for capturing fertility differentials. *Age at arrival in the host* country differentiates between those who arrived as children (by age 15) and are called generation 1.5 (G1.5), and those who arrived as adults and are called first-generation immigrants (G1). This distinction is important, as it helps us capture the extent to which socialisation in the host country affects family formation and fertility in immigrant populations. First-generation immigrants are further split by the *duration of stay* in the host country (0–4 years, five or more years) in order to capture potentially elevated fertility rates after the time of arrival (tempo effect).

The resulting migration variable is coded into 16 categories:

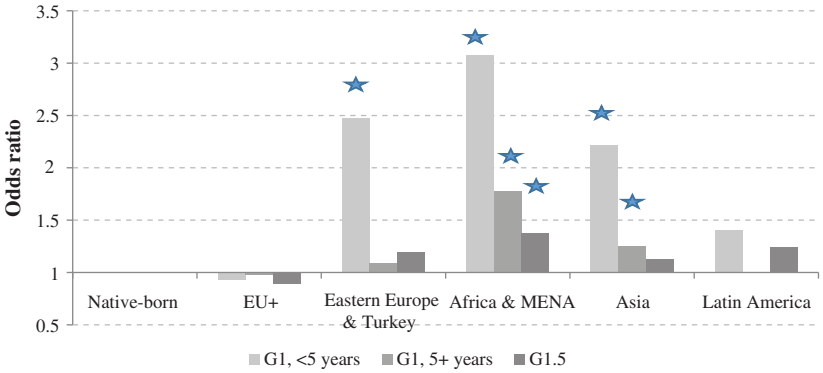
- native-born,
- G1 EU+ immigrant, in the country for less than five years,
- G1 EU+ immigrant, in the country for more than five years,
- G1.5 EU+,
- and so on for the other four regions of birth.

Figure 1 illustrates the odds ratios derived from β_8. They show that even after controlling for age and education, immigrant women from outside the EU+ tend to have higher fertility than native-born women. As expected, the results indicate that first-generation (G1) immigrants who only recently arrived in the host country have the highest risk of having a young child, probably due to a period effect after migration that arises from the interrelation of life events, and that is also influenced by the reasons for migration. The odds are lower for G1 women resident in the host country for at least five years, but these women still have higher odds than those who arrived as children (by age 15, G1.5). This finding is again consistent with the existing studies, and is usually interpreted in the context of the socialisation and adaptation hypotheses. The differentials are particularly pronounced for women from Africa and MENA, who have significantly higher odds. This is the case even for G1 immigrants with a longer duration of stay and for G1.5 immigrants, although the gradient is as expected, and the odds decrease. For Asian women, we can see that G1.5 immigrants do not differ significantly from their native-born counterparts.

[17] MENA stands for Middle East and North Africa.

[18] Not all of the 28 member states provide the data coded into all 21 detailed regions. Immigrants from EFTA, North America, and Australia are grouped with EU28 migrants, as they have similar fertility levels. We did not add them to Eastern Europe + Turkey because the differentials in this region are clearly determined by Turkish women. Germany does not provide data on the country of birth for those not born in Germany. Therefore, we have imputed the foreign country of birth using citizenship information (imputed 55% of missing cases). Naturalised immigrants with German citizenship are excluded from the analysis. Of the imputed cases, 45% were resident in Germany less than 10 years, compared to 6.5% for naturalised immigrants. Given that fertility peaks in the years immediately after migration, the exclusion of naturalised immigrants should not greatly alter the results.

Figure 1:
Odds of having a child by region of origin, generational status, and duration of stay, native-born = reference category



Note: Statistically significant results at the 0.05 level marked by an asterisk.
Source: LFS 2014–2016 yearly data, publicly available scientific datasets.

For women from Eastern Europe and Turkey, we observe significantly higher odds of having a young child for recent G1 immigrants only. Immigrant women from other EU+ countries do not differ significantly from native-born women.

In the microsimulation, we are simulating the life courses of individuals in continuous time.[19] The advantage of this approach is that it enables us to link a woman's fertility to stages in her educational career, as a woman who is still in education is less likely to have a child than a woman with completed education, even though the actual educational attainment levels of these women are the same at a given age. The parameter for the student status reduces fertility for women who are in full-time education. Looking at the results of the regression model, we can see that a woman who is in education has about 10 times lower odds of having a child than a woman who has completed her education (odds ratio of 0.123 after controlling for control variables).

In order to use in the microsimulation the baseline rates by age and education of Lutz et al. (2018), the parameters for the student status (β_9) and the migration status (β_8) are compared to the weighted population average (using the option contrast gw in STATA 15.1).[20] For instance, the odds ratio for a student compared to the weighted average population changes from 0.123 to 0.168; and, conversely, an odds ratio of 1.365 is applied to the non-student (again, compared to the weighted average

[19] The modelling of fertility from a period perspective does not necessarily reflect the cohort's life course behaviour, particularly for immigrant women who may have had children prior to arrival.

[20] LFS dataset is reweighted by the base population of the microsimulation model in order to use identical reference populations.

population). In the fertility module, parameters β_0 to β_7 (control variables, age and education) are replaced by the age- and education- specific fertility rates by country taken from the baseline scenario. The EDU scenario simply replicates the fertility rates by age and education of CEPAM-mac by switching β_8 and β_9 to zero. In the second EDU + STUDENT scenario, we switch on the β_9 parameter, and thus add the differentials by student status to the model. In the third EDU + STUDENT + IMMIG scenario, we switch on the migration status (β_8) and obtain the full model. These steps are repeated for the high migration scenarios. In all of these scenarios, the parameters for student status and migrant status are held constant.

4 Results

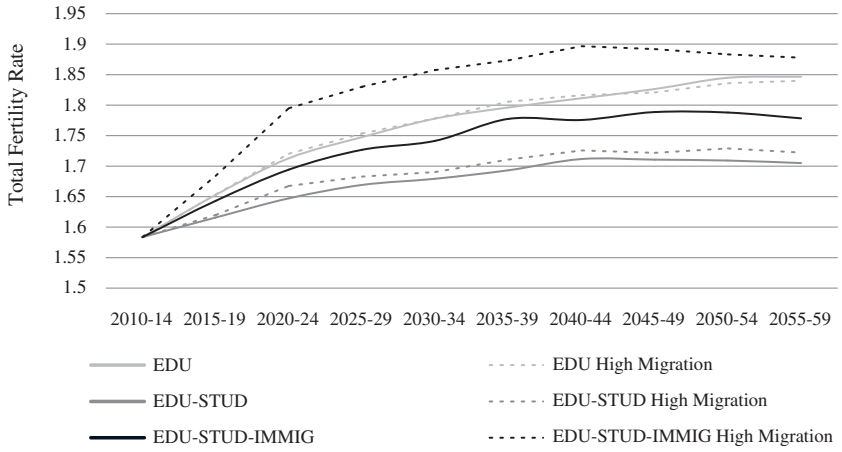
The resulting TFRs for the EU28 in the projection scenarios are shown in Figure 2. The increases in the TFRs found for all scenarios result from the general trends set in the assumptions of the reference scenario of Lutz et al. 2018, for more details, see also Basten et al. 2014). The baseline EDU scenario (yellow line) assumes that the TFR increases from 1.65 in 2015–19 to 1.85 in 2050. The differences between the EDU scenario and the additional scenarios reflect the impact of accounting for heterogeneity in fertility behaviours with respect to education and migration, and the variations in the composition of women of reproductive age. If we consider all differentials (by educational attainment, for students and for immigrants), we arrive at lower TFRs that peak at 1.79 children per woman. This result is driven by educational expansion, as illustrated by the EDU + STUDENT scenario that projects a TFR of 1.71 in 2040–59. The projected TFRs in the EDU + STUDENT scenario are lower because in this scenario, the shares of young women enrolled in higher education who have very low fertility while enrolled are increasing. Once we differentiate between the native-born women and various groups of immigrant women (EDU + STUDENT + IMMIG scenario), the overall TFR increases, but to a lower level than in the EDU scenario.

The gap in the fertility levels of EU-born women and foreign-born women is caused by both the educational composition and the migrant characteristics of foreign-born women (Figure 3). In the EDU + STUDENT scenario, in which we do not account for migrant characteristics, foreign-born women have 0.14 to 0.19 points higher TFRs than the TFRs of higher educated EU-born women. In the EDU-STUDENT scenario, the TFRs depend only on the educational composition and the share of women in education.

Once we account for fertility differences across various groups of foreign-born women, the estimated TFR of the foreign-born women increases to 2.5–2.6. The estimated TFR of the EU-born women is about 1.65[21] (EDU + STUDENT + IMMIG scenario in Figure 3).

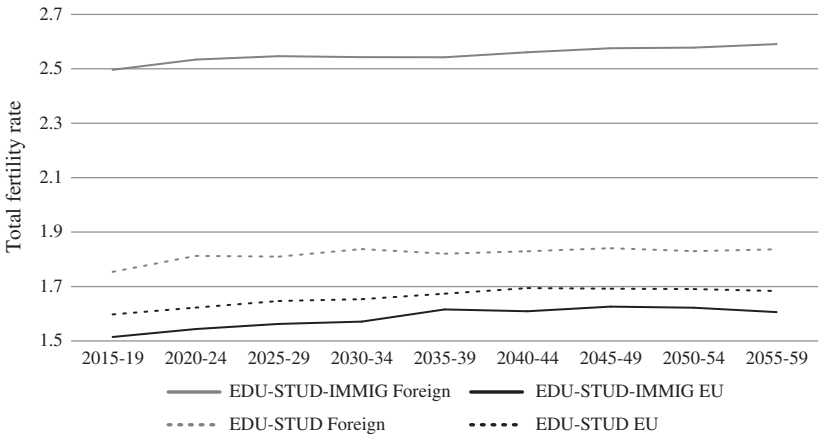
[21] Includes both native-born and EU-mobile female citizens.

Figure 2:
Past and projected total fertility rates (TFR) for the EU28 in four selected scenarios



Source: EUROSTAT (2010–2014) and CEPAM (2015–2060)

Figure 3:
Estimated TFRs of EU-born and foreign-born women by scenario



Source: CEPAM (2015–2060)

The impact of the fertility patterns of foreign-born women on overall fertility depends on the volume of migration and the stock of foreign-born women of fertile age in the baseline population. If both the fertility differences between native-born and foreign-born women and the current migration flows persist at recent levels,

the overall TFRs in the EDU scenario and in the EDU + STUDENT + IMMIG scenarios turn out to be very similar. The net effect of immigrant fertility on the overall TFR increases from 0.12 points in 2015–19 to 0.17 points in 2055–59 (Table 2). At current fertility levels, a two-fold increase in immigration from non-EU countries results in a rapidly increasing overall TFR peaking at 1.9 in 2040–44. In the high migration scenario, the net effect of immigrant fertility rises to 0.25 in 2055–59 (Table 2). This finding reflects the rapidly increasing population of immigrant women in the EU population, which is projected to rise from an estimated 10.4 million in 2015 to 38.1 million in 2055 under high migration assumptions, but to just 19.3 million under baseline migration assumptions (Table 3). The share of immigrant women of reproductive age is projected to increase from 10.5% in 2015 to about 30% in 2060 in the high migration scenario, but to only 20% in 2060 in the scenarios with baseline migration (Table 3).

The compositional effects of increased immigration on the overall projected TFRs are more pronounced in countries with larger stocks and projected flows of immigrants from third countries, some of which are listed in Table 2. At current differentials, the net effects of immigrant fertility are projected to be the most pronounced in Sweden, with the projected share of foreign-born women of reproductive age expected to increase from 23% in 2015 to 30% in the baseline migration scenario, and to 39% in the high migration scenario.

In the scenarios with baseline migration, the projected number of births declines from an estimated 26.0–26.5 million in 2015–19 to 23.1–25.7 in 2055–59 (Figure 4). These decreases occur despite the assumed increases in the TFRs (Figure 2) because the number of women of reproductive age declines from 112 million in 2015 to 97 million in 2055 (Table 3), even at sustained recent past immigration volumes. In the doubled migration scenario, the projected population of women of reproductive age increases to 126 million in 2055. In combination with current fertility differentials, this results in a steadily increasing projected number of births in all of the high migration scenarios (Figure 4). When we compare the EDU and the EDU high migration scenarios, we see that a doubling of migration results in 2% more births in 2015–19, with a gradual upward trend to 28% more births in 2055–59. In the EDU + STUD + IMMIG scenarios, larger increases in immigration result in 5% more births as early as in 2015, and 41% more births in 2055 (34.9 million vs. 24.8 million, see also Table 4).

In the EDU scenarios, the number of births is boosted by additional births to students who are assumed to have the same fertility rates as their peers with completed education. The difference in the projected number of births in the EDU and EDU + STUDENT scenarios gradually increases from 2% to 10% over the projection period. The EDU + STUDENT scenario assumes that there are no fertility differentials between native-born and foreign-born women with the same educational levels. If this is indeed the case, and the immigration flows continue to be of magnitudes similar to those in the recent past, the projected number of births will fall below 24 million by 2060.

Table 2:
Projected TFRs in 2015–19 and 2055–59, TFRs of EU-born women, and the net effect of immigrant fertility on the overall TFR in selected countries

	Projected overall TFR			Projected TFR of EU-born women			Net effect of immigrant TFR		
Period	**2015–19**	**2055–59**	**2055–59**	**2015–19**	**2055–59**	**2055–59**	**2015–19**	**2055–59**	**2055–59**
Scenario	**EDU-STUDENT-IMMIG**	**EDU-STUDENT-IMMIG**	**EDU-STUD-IMMIG - HighMig**	**EDU-STUDENT IMMIG**	**EDU-STUDENT IMMIG**	**EDU-STUD-IMMIG - HighMig**	**EDU-STUDENT-IMMIG**	**EDU-STUDENT-IMMIG**	**EDU-STUD-IMMIG - HighMig**
Germany	1.49	1.68	1.78	1.36	1.50	1.52	0.13	0.18	0.26
France	2.01	1.85	1.96	1.80	1.66	1.67	0.20	0.19	0.29
Italy	1.51	1.65	1.73	1.40	1.50	1.51	0.12	0.15	0.22
Spain	1.39	1.76	1.86	1.32	1.59	1.65	0.07	0.17	0.21
Sweden	1.92	1.98	2.10	1.65	1.70	1.73	0.27	0.28	0.37
UK	1.91	1.84	1.96	1.74	1.66	1.70	0.17	0.18	0.26
EU28	**1.64**	**1.78**	**1.88**	**1.52**	**1.61**	**1.63**	**0.12**	**0.17**	**0.25**

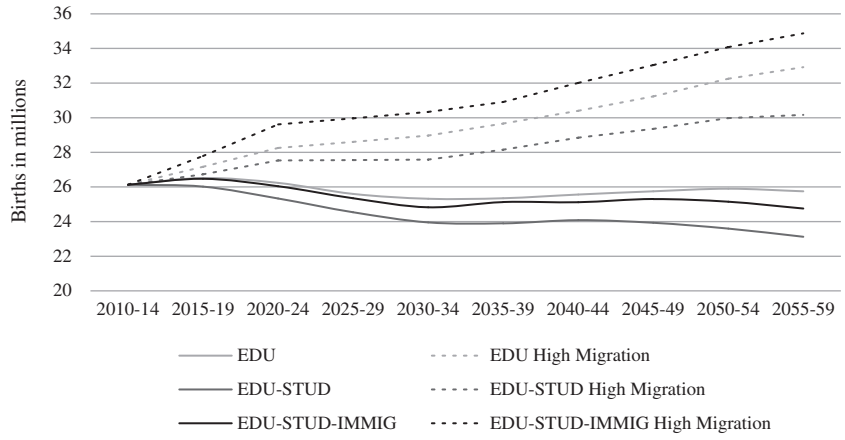
Note: The net effect is computed as the difference between the overall TFR and the TFR of EU-born women.

Table 3:
Projected size and composition of women of reproductive age in EU28

	2015	2025	2035	2045	2055
	Proportion of women aged 15–49 born outside EU				
EDU + STUDENT + IMMIG	11%	16%	19%	20%	20%
EDU + STUDENT + IMMIG High migration	11%	21%	28%	31%	30%
	Women of reproductive age (15–49), millions				
EDU + STUDENT + IMMIG	112	104	100	97	97
EDU + STUDENT + IMMIG High migration	112	112	116	120	126

Source: EUROSTAT (2015) and authors (2020–2055)

Figure 4:
Projected births in the EU28 in the projection scenarios considering various fertility differentials and immigration assumptions



Source: EUROSTAT (2010–2014) and CEPAM (2015–2060)

When we look at the overall TFRS and the projected births in the EDU and EDU + STUDENT + IMMI scenarios, it may appear that modelling fertility with a broader set of differentials does not affect the projection results enough to compensate for the additional complexity in the estimations that need to be performed to arrive at a set of fertility parameters that capture an increased number of dimensions. However, this is the case only if we assume that there is no change in immigration among third-country nationals. A set of scenarios with doubled immigration (dotted lines in Figure 4) show sizeable differences in the projected number of

Table 4:
Projected births (in millions) in the full model with baseline and double migration, selected countries

Scenario	EDU + STUDENT + IMMIG		EDU + STUDENT + IMMIG high migration		Scenario difference	
Period	**2015–19**	**2055–59**	**2015–19**	**2055–59**	**2015–19**	**2055–59**
Germany	3.7	4.1	4.0	6.0	0.24	1.89
France	4.1	3.6	4.3	5.0	0.20	1.36
Italy	2.7	2.4	2.8	3.3	0.12	0.90
Spain	2.1	1.8	2.2	2.7	0.09	0.88
Sweden	0.6	0.8	0.7	1.4	0.07	0.51
UK	4.2	4.2	4.4	6.1	0.22	1.86
EU28	**26.5**	**24.8**	**27.8**	**34.9**	**1.32**	**10.12**
	EDU + STUDENT		**EDU + STUDENT high migration**		**Scenario difference**	
	2015–19	**2055–59**	**2015–19**	**2055–59**	**2015–19**	**2055–59**
Germany	3.6	3.7	3.8	5.1	0.13	1.37
France	4.1	3.5	4.1	4.4	0.10	0.94
Italy	2.6	2.2	2.7	2.8	0.06	0.64
Spain	2.1	1.7	2.1	2.4	0.06	0.68
Sweden	0.6	0.8	0.6	1.1	0.04	0.35
UK	4.1	4.0	4.2	5.2	0.12	1.22
EU28	**26.0**	**23.1**	**26.7**	**30.2**	**0.7**	**7.0**

Source: Authors' computations.

births depending on how the fertility differentials are modelled. Similarly, country-specific results for selected EU countries that are major destination countries of immigrants presented in Table 4 show, with the exception of Germany, a decline in the number of projected births in the EDU + STUDENT + IMMIG scenario with baseline migration, but a sizeable increase in the scenario with doubled migration and at constant fertility differentials. In the case of Sweden, the high migration EDU + STUDENT + IMMIG scenario results in a doubling of the number of births in 2055–59 compared to in 2015–2019. If differences in fertility between the EU-born and the native-born mothers are not taken into account, and only educational differentials are included (EDU + STUDENT), the overall number of births is lower and the surplus in the EDU + STUDENT high migration scenario is smaller than in the full model.

This sensitivity analysis shows that the simple modelling of fertility in the EDU scenario coincidentally captures the effect of the higher fertility rates of immigrant women through the higher fertility rates of women in education at younger reproductive ages. The majority of immigrants arrive as young adults and

Table 5:
Projected births to non-EU-born mothers (in %)

	Proportion of births to foreign-born mothers (non-EU)				
Scenario	**2015–19**	**2025–29**	**2035–39**	**2045–49**	**2055–59**
EDU	14%	18%	19%	19%	19%
EDU + STUDENT	15%	19%	21%	21%	21%
EDU + STUDENT + IMMIG	20%	26%	27%	27%	28%
EDU + STUDENT + IMMIG high migration	24%	37%	41%	41%	39%

Source: Authors' computations.

have elevated fertility in the years immediately after migration, while a sizeable proportion of native-born women are still in education and have low fertility by age 25. Thus, the surplus births in the EDU scenario arise because women enrolled in education are not differentiated from women with completed education. This could, however, change in the future if, for instance, future immigrants arrive mainly as students, or are educated at the same or higher levels than native-born women.

Finally, one of the most interesting and relevant results of our analysis with respect to the increasing diversity of European population is the estimated composition of births by the nativity status of the mother. According to our estimates, if recent migration volumes and fertility differentials persist, this share may increase to 28% by 2055–59 in the EU28 (Table 5). Naturally, the share is largest (39% in 2055–59) in the high migration scenario – nearly double the share in the EDU scenario that includes only educational attainment differentials. Already in the first projection step, we can see a difference of six percentage points compared to the baseline model (EDU) and the full model (EDU + STUDENT + IMMIG) with differentials by region of birth, duration of stay, and generation.

5 Conclusions

Our results illustrate that in the context of educational expansion and increasing population diversity due to immigration, population projections for the EU countries should account for several sources of population heterogeneity. We have shown that how fertility differentials are modelled affects projection results, especially when looking at projected births. Moreover, we have demonstrated that changes in the composition of women of reproductive age in terms of their educational attainment and migrant status can affect both overall TFRs and projected births.

When studying the impact of education on fertility, it is important to capture the postponement effect that is largely driven by educational expansion. This issue

becomes particularly relevant if we assume that post-secondary education will expand in the future, because this expansion will translate into increasing shares of women staying in education until later reproductive ages. We show that the conventional modelling that does not differentiate between the fertility of students and women with completed education results in higher estimated TFRs. Once we account for the lower fertility rates of women enrolled in higher education, the resulting TFRs decline at current fertility differentials. If education differentials were to narrow, or if the negative relationship between fertility levels and educational attainment were to even reverse, the resulting TFRs and the projected births would also be affected. But in these projections, we do not model these hypothetical situations.

A comparison of the EDU scenario and our full model shows that the TFRs and the projected births are similar under baseline migration assumptions. This holds at the current fertility differentials and at the current composition of immigrant women.

The results for the projected births and TFRs are sensitive to migration assumptions. Our high migration scenario shows steadily increasing numbers of projected births, whereas the scenarios with baseline migration based on recent trends project declining births. The net effect of immigrant fertility on the overall TFR in the EU28 is projected to increase from 0.12 in 2015–2019 to 0.17 in 2055–59 in the scenario with baseline migration, and to 0.25 in 2055–59 in the scenario with doubled migration. The net effects and the projected increases in births in countries with larger foreign-born population shares are more pronounced under the assumption of sustained high migration.

We have held the composition of immigration flows constant in order to facilitate the assessment of the impact of fertility modelling on the projection results. Naturally, changing the composition of the flows in terms of the countries of origin is another source of heterogeneity that can impact the projection results. The investigation of the impact of such an exercise is beyond the scope of this paper, but it is feasible using experimental what-if scenarios. If more future immigrants come from high-fertility countries, it is possible that the net effect of immigrant fertility will be more pronounced even if the size of the flow does not change. Fertility is expected to decline to close to the replacement level in some of the major sending countries, and this trend could lead to less pronounced differentials between the native-born and immigrants in the future.

The pace of educational expansion in the countries of origin and the selection of migrants may also change in future. In addition, if more female migrants from third countries start immigrating to study or to seek job opportunities rather than for family reasons, we may see immigrant fertility rates converge more quickly to native-bon levels, and narrower fertility differentials between native-born and immigrant women. A hypothetical situation with no differentials between native-born and immigrant women with same educational attainment is illustrated by our EDU + STUDENT scenario.

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Decomposing changes in first birth trends: quantum, timing, or variance

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Abstract

In high-income countries, women and men born since the 1940s have delayed the birth of their first child, more of them have remained childless, and the timing of the first birth has become more diverse in these cohorts. The interaction between these three trends makes the research on first birth patterns more complex. This study has two main aims: (1) we introduce an alternative index, Expected Years Without Children (EYWC), to quantify changes in first birth behaviour; and (2) we decompose the changes in EYWC over time into three effects: remaining permanently childless, postponing the first birth, and the expansion of the standard deviation of the mean age at first birth. Using data from the Human Fertility Database, EYWC is calculated to illustrate time trends among women born in the 1910s–1960s in eight countries with longer series of data on cohort first birth trends: Canada, the Czech Republic, Japan, the Netherlands, Norway, Portugal, Sweden, and the United States. Our decomposition shows that the changes in EYWC are mainly attributable to postponement in North America and northern Europe, whereas these changes are largely due to increasing shares of women remaining childless in Japan and Portugal.

Keywords: childlessness; postponement of first birth; decomposition method; Coale-McNeil model; life table

1 Introduction

The share of childless women has steadily increased in recent decades in high-income countries. For example, according to Kreyenfeld and Konietzka (2017), more than 20% of women in German-speaking countries were childless at the end

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of their reproductive period since the 1950s birth cohorts. This increasing trend can be observed throughout Europe (Beaujouan et al. 2016; Miettinen et al. 2015; Kreyenfeld and Konietzka 2017), North America (the US: Frejka 2017, Canada: Ravanera and Beaujot 2014) and Japan (Raymo et al. 2015). It has also been projected that the future level of childlessness will increase as the fertility patterns of countries diverge (Sobotka 2017). Becoming a parent or remaining childless influences various aspects of a man's or a woman's life, including the individual's income (Budig et al. 2012), health (Kendig et al. 2007), old-age well-being (Huijts et al. 2013; Zhang and Hayward 2001), and support networks (Albertini and Kohli 2009). Therefore, it is important that we gain a deeper understanding of the trend of childlessness. The increase in the number of childless women has coincided with an increase in the mean age at first birth. For instance, in the OECD countries, the mean age at first birth has increased by about one year each decade since the 1970s (Mills et al. 2011). Thus, in these decades, levels of childlessness have risen (*quantum* changes) and the first birth has been increasingly postponed (*timing* changes).

The most common indices used to measure first birth trends, the proportion of childless women at age 50 and the mean age at first birth, are useful for studying either quantum changes or timing changes, but not for studying both. This is simply because the proportion of childless women does not take into account the timing changes (e.g., the same proportion of childless women can reflect different mean ages at first birth), and the mean age at first birth per se does not show quantum changes. Previous research has investigated how changes in the timing of the first birth affect the level of childlessness. For instance, Kneale and Joshi (2008) explored the extent of childbirth postponement and projected its impact on eventual levels of childlessness in the UK. Similarly, te Velde et al. (2012) estimated the effect of postponement of entry into motherhood on permanent involuntary childlessness in six European countries.

In this study, by contrast, we suggest an alternative index that takes both quantum and timing changes into account in a single index: Expected Years Without Children (EYWC). This index measures the average length of life women spend without children during their reproductive period by estimating both the life years of women who remained childless at the end of their reproductive period (quantum) and the life years of women before they had a child (timing). The concept of EYWC was previously introduced by Bongaarts and Feeney (2006) in fertility research, and was employed by Andersson et al. (2017) to describe contemporary family changes using a life table method. However, these authors did not focus on the index per se, nor did they depict its trends. Therefore, the first aim of this study is to present the trend in EYWC in order to show how first birth trends have changed due to both quantum and timing changes.

Our second aim is to quantify which of two effects, remaining permanently childless or postponing the first birth, has the most impact on changes in first birth behaviour. Although those two phenomena are the main focus in this study, an additional component, the variance in the age at first birth, is investigated. When the mean age at first birth increases, the variance in the timing of the first birth in a

given population becomes larger (Kohler and Philipov 2001). In part because of this expansion of the timing of the first birth, the family life courses of women diverge more across birth cohorts (Elzinga and Liefbroer 2007). Therefore, we quantify the effects of remaining permanently childless, postponing the first birth, and the expansion of the timing of the first birth on the changes in EYWC over time using a decomposition method presented by Mogi and Canudas-Romo (2018).

In the following section, we explain our methods – a parametric model for a first birth, the main measure used to describe the first birth trend (EYWC), and the decomposition method – as well as the data we used. In the third section, we present the trend in EYWC and the results of its decomposition. In the final section, we conclude by discussing our findings, the limitations of our study, and future research directions.

2 Data and methods

2.1 Data

In this study, we used female population counts by age and birth cohort and birth counts by birth order and mother's cohort from the Human Fertility Database (HFD) (Human Fertility Database 2018). To avoid problems arising from truncation and censoring bias, we used completed cohort fertility data only. Based on these criteria, data from eight countries were selected: Canada (1929–1962 birth cohort), the Czech Republic (1935–1965 birth cohort), Japan (1953–1965 birth cohort), the Netherlands (1935–1963 birth cohort), Norway (1952–1965 birth cohort), Portugal (1944–1966 birth cohort), Sweden (1955–1965 birth cohort), and the US (1918–1965 birth cohort).

2.2 Coale-McNeil model for first birth

While the parametric model for overall fertility is well developed (see, for example, Kostaki and Paraskevi 2007), there are few models that measure the first birth. In this study, we use the Coale-McNeil model (CM model) to estimate the age-specific first birth rate. The parameters of the CM model have conventional demographic meanings, and fit best with the aim of our study, which is to quantify the effects of remaining permanently childless and postponing fertility.

The CM model was developed to estimate the age at first marriage patterns of a birth cohort (Coale and Trussell 1978). The CM model has since been extended beyond its original purpose, and has often been applied to the first birth distribution by age (Bloom 1982*a*,*b*; Bloom and Trussell 1984; Henz and Huinink 1999; Rao 1987; Trussell and Bloom 1983). Previous studies successfully applied the CM model to various countries, including Canada, Columbia, Finland, Germany, Italy, and the US. The advantage of using the CM model is that its parameters have clear demographic meanings, which are as follows. The probability of first birth at age x

and time t, denoted as $f_{x,t}$, is expressed as:

$$f_{x,t} = C_t \frac{1}{\sigma_t} a_1 \exp\left[a_2\left(\frac{x-\mu_t}{\sigma_t} + a_3\right) - \exp\left\{-a_4\left(\frac{x-\mu_t}{\sigma_t} + a_3\right)\right\}\right], \quad (1)$$

where C_t pertains to the proportion of the cohort eventually having a child by age 50 at time t, μ_t refers to the mean age at first birth at time t, σ_t is a measure of the standard deviation of age at first birth at time t, and the usual values for the constants are $a_1 = 1.281$, $a_2 = -1.145$, $a_3 = 0.805$, and $a_4 = 1.896$. This equation is known as a standardised version of the CM model developed by Rodríguez and Trussell (1980).

Although several models have been used to estimate first birth patterns, these models are not fully applicable to our study. First, for one feature of the CM model (the convolution structure), an additional term has been proposed: namely, an exponentially distributed waiting time segment to account for the time from first marriage to first birth. However, Trussell and Bloom (1983) reported that the original CM model fitted better than the model with the waiting term. Thus, previous research applied the CM model to first birth patterns without using the additional waiting time segment (Bloom 1982*a*,*b*; Bloom and Trussell 1984, Henz and Huinink 1999, Rao 1987, Trussell and Bloom 1983). In addition, this approach is not theoretically appropriate given the current data. As nonmarital childbirth has become common in many high-income countries (Eurostat 2018; Department of Health and Human Services 2018), the first birth does not always occur after marriage. Thus, the additional term that considers the period from marriage to childbirth is not relevant to the data in our study. The second model is a log-logistic function (LL model). Henz and Huinink (1999) applied it to the first birth in the German data. However, it does not have a scale parameter, which indicates the proportion of the population who never had children. Hence, it is not applicable given our aim and decomposition method.

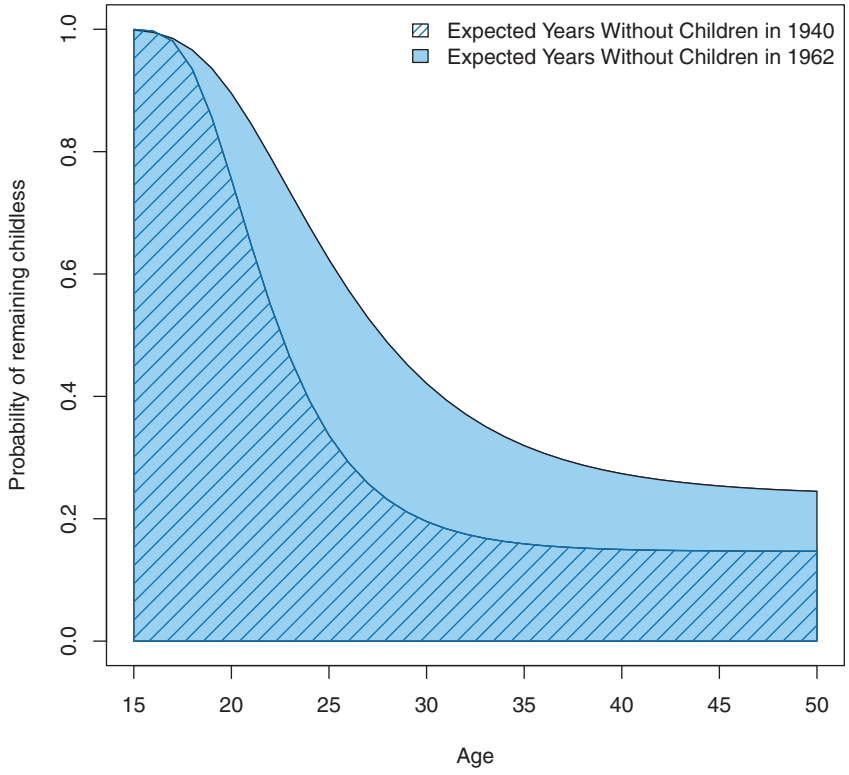
Although the CM model is widely used to study first birth trends, whether the CM model fits well with the observed pattern of the age at first birth has not been statistically examined. The goodness-of-fit using the Kolmogorov-Smirnov tests shows that the CM model estimates well the data for all the countries and years (see Appendix A). For these reasons, we have chosen to use the CM model to explore the changes over time in first birth behaviours and the expected years without children (EYWC).

However, the limitations of the CM model should be mentioned. There are statistical issues when the CM model is used to estimate the mean and the standard deviation of age at first birth (Bloom and Trussell 1984): (1) if the sample available for estimation is restricted to women who have become mothers on or before the survey date, a truncation bias problem will arise; and (2) if the data used for estimation refer to a sample of all women, there will be a censoring problem if any of the women who will ultimately have a first birth have not done so by the time of the survey (Bloom and Trussell 1984). We avoid those problems by using completed cohort fertility data from the HFD.

2.3 Expected years without children (EYWC)

We use life expectancy to measure fertility behaviours. In classical life table methods, life expectancy between two ages (e.g., 0 and X) represents the area below a survival function from age zero to the fixed age X. This is interpreted as the average number of years people live between these ages (Preston et al. 2001). In this research analysing first birth trends, life expectancy is interpreted as the expected years without children, with a first birth representing a "death". The minimum age is the age of first menstruation and the maximum age is the age of menopause. Therefore, the EYWC from age 15 to age 50, denoted as ${}_{35}e_{15}$, is calculated as ${}_{35}e_{15}(t) = \int_{15}^{50} l_{x,t}\, dx$. It corresponds to the two shaded areas in Figure 1 for the

Figure 1:
Probability of remaining childless by age among a Canadian female birth cohort in 1940 and 1962



Note: The parameters of the probabilities of remaining childless are $C = 0.85$, $\mu = 23.10$, and $\sigma = 4.14$ for the 1940 birth cohort and $C = 0.76$, $\mu = 26.98$, and $\sigma = 6.88$ for the 1962 birth cohort.
Source: Authors' calculations using the Human Fertility Database.

1940 and the 1962 birth cohorts. The use of EYWC has two primary advantages. First, as this index is able to capture fertility trends in one simple value, it can be used to numerically compare fertility trends at different times and in different countries. Second, it can take into account both the population having children and the population without children. While the most common indices used to study first birth trends are the mean age at first birth and the proportion of childless women, the EYWC index can reflect those two indices simultaneously. These features are very useful in the current context, in which both indices have an increasing trend.

2.4 Decomposition method

We applied the decomposition method developed by Mogi and Canudas-Romo (2018). A detailed explanation can be found in their study (Mogi and Canudas-Romo 2018). The changes in EYWC over time, denoted as ${}_{35}\dot{e}_{15}(t)$, are decomposed into three parameters: scale (the proportion of the cohort eventually having a child), location (the mean age at first birth), and variance (the standard deviation of age at first birth). The decomposition of ${}_{35}\dot{e}_{15}(t)$ can be formulated as

$$ {}_{35}\dot{e}_{15}(t) = \frac{\partial\, {}_{35}e_{15}(t)}{\partial C_t}\dot{C}_t + \frac{\partial\, {}_{35}e_{15}(t)}{\partial \mu_t}\dot{\mu}_t + \frac{\partial\, {}_{35}e_{15}(t)}{\partial \sigma_t}\dot{\sigma}_t, \tag{2} $$

where each term is the change in ${}_{35}\dot{e}_{15}(t)$ resulting from changes in the scale, location, and variance. A dot on top of a variable indicates the derivative with respect to time. The largest value among these three components shows that the changes in EYWC are mainly caused by that factor; i.e., scale factor ($\frac{\partial\, {}_{35}e_{15}(t)}{\partial C_t}\dot{C}_t$): remaining permanently childless, location ($\frac{\partial\, {}_{35}e_{15}(t)}{\partial \mu_t}\dot{\mu}_t$): postponing first birth, or variance ($\frac{\partial\, {}_{35}e_{15}(t)}{\partial \sigma_t}\dot{\sigma}_t$): expansion effect. Appendix C explains the detailed method for estimating the three parameters of the CM model and applying the decomposition equation to discrete data.

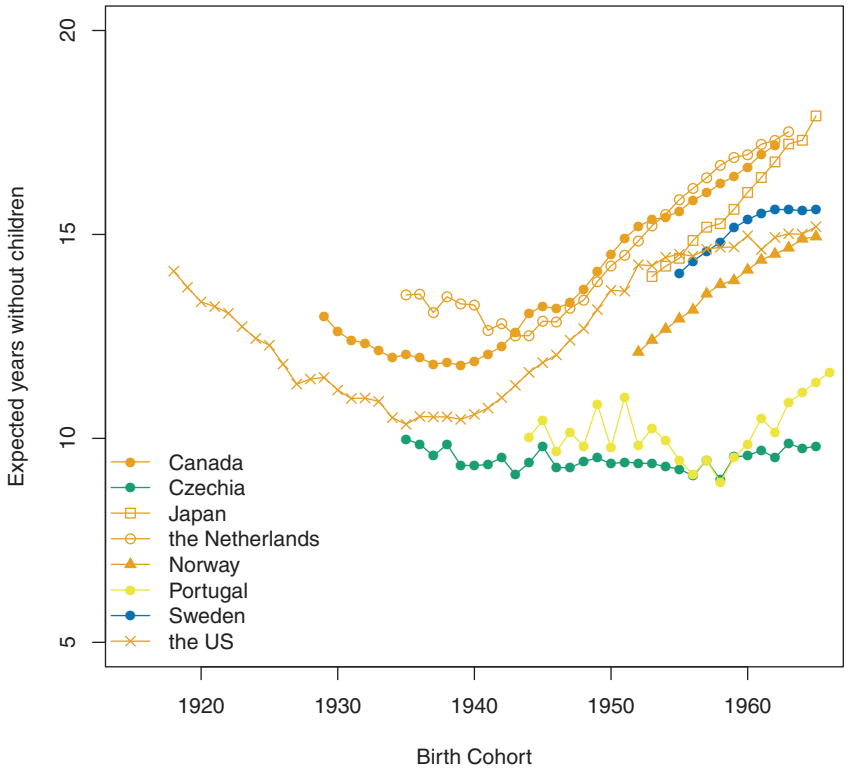
3 Results

3.1 Cross-country trend analysis of EYWC

The trends in EYWC for the selected countries are presented in Figure 2.

Figure 2 shows that most of the countries in the study had an increasing trend in EYWC starting with the 1940s birth cohorts. The EYWC in Canada declined until the 1940s birth cohorts, and then started steeply increasing. The 1940 birth cohort in Canada had 12 years of EYWC. This value had increased to 16.6 years for the 1960 cohort. As EYWC represents the expected number of years without children starting from age 15, each number signifies that the expected age at first birth in the specific cohort in a country is 15+ EYWC. Thus, we can interpret these

Figure 2:
Time trends in expected years without children in eight countries



Source: Authors' calculations using the Human Fertility Database.

findings as showing that the expected age at first birth increased from 27 (15 + 12) in the 1940 birth cohort to 31.6 (15 + 16.6) in the 1960 birth cohort. The US had an increasing trend similar to that of Canada until the 1950s birth cohorts. In the US, the EYWC increased sharply from the 1940 birth cohort (10.5 years) to the 1950 birth cohort (13.6 years). However, this increasing trend slowed after the 1950 birth cohort. The EYWC in the US increased by only 1.3 years from the 1950 to the 1960 birth cohort. In the Netherlands, the EYWC increased starting with the 1945 birth cohort, from 13 years for the 1945 birth cohort to 17 years for the 1960 birth cohort. Moreover, in several other countries, such as in Japan and Norway, the EYWC displayed an increasing trend for all the observable periods. In Japan, the EYWC rose from 14 years for the 1953 birth cohort to 18 years for the 1965 birth cohort. In Norway, the EYWC increased from 12 years for the 1952 cohort to 15 years for the 1965 cohort.

The EYWC trends in Portugal, Sweden, and the Czech Republic differ from those in the countries discussed above. In Portugal, the EYWC fluctuated by

approximately 10 years between the 1940s and 1950s birth cohorts. However, by the 1960 birth cohort, the EYWC in Portugal had increased, and it is currently estimated at 11.6 years for the latest observed birth cohort. By contrast, in the Czech Republic, the EYWC trend has been neither increasing nor decreasing, as it has plateaued at 10 years for all observable birth cohorts from 1935 to 1965. Interestingly, in Sweden, the EYWC trend has also plateaued in recent cohorts. After increasing starting with the 1955 birth cohort (14.4 years), the EYWC trend had plateaued at 16 years by the 1960 birth cohort.

Among the latest birth cohorts we can observe, the EYWC was approximately 17.5 years in Canada, Japan, and the Netherlands; and was approximately 15 years in Norway, Sweden, and the US. The EYWC values in these countries were followed by those in Portugal, at 11.5 years; and in the Czech Republic, at less than 10 years. Lower EYWC values indicate that, on average, the women in the population gave birth to their first child at an early age. The latest cohort observed in Canada, Japan, and the Netherlands spent half of their reproductive period with no children (the expected age at first birth is 15 + 17.5 = 32.5). In other words, these women have only have 17.5 years left in their reproductive period, on average, to have any subsequent children.

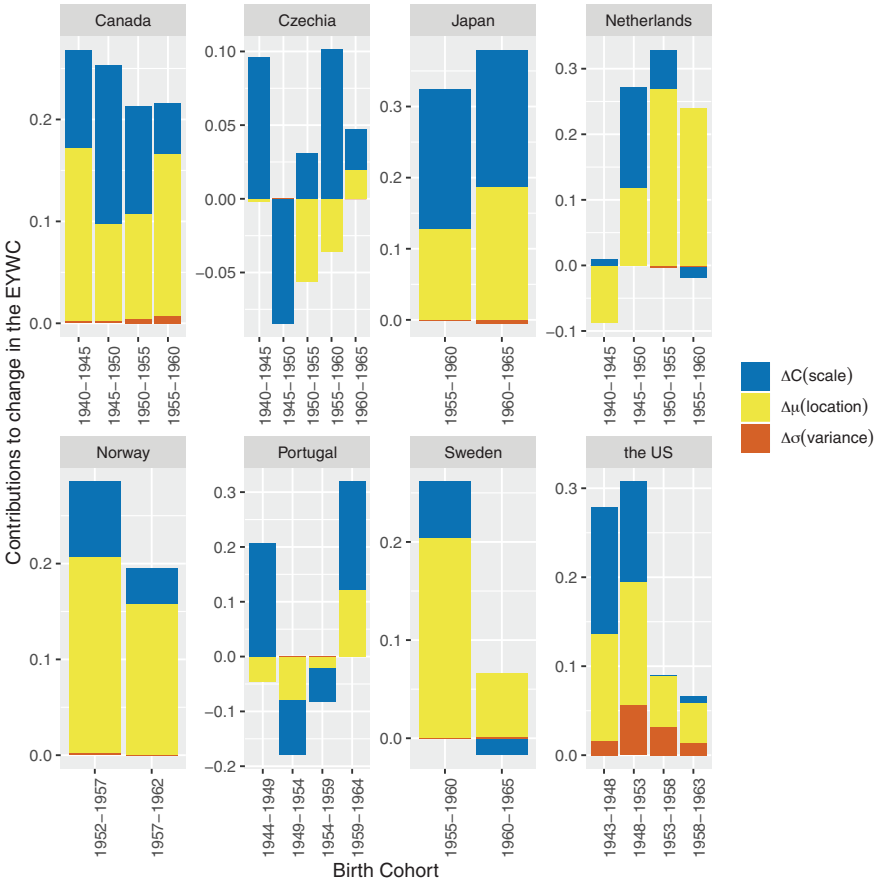
The main objective of this study is to investigate whether the changes in EYWC, as shown in Figure 2, are attributable to women remaining permanently childless or postponing childbirth, or to the expansion effect. We decompose EYWC from 1940 onwards; the results are presented in Figure 3.

3.2 Decomposition of EYWC

In Canada, the US, the Netherlands, Sweden, and Norway, the location parameter (the timing of first birth) was the most influential factor in the changes in EYWC after 1950. Table 1 shows that 74% of the increase in the EYWC in Canada from 1955 to 1960 was due to the increase in the average age at first birth. Similar results can be reported for the US: 68% of the increase in the EYWC from 1958 to 1963 in the US can be attributed to the increase in the average age at first birth. Likewise, in Norway, the increase in the average age at first birth was responsible for 81% of the increase in the EYWC from 1957 to 1962. The results for the Netherlands and Sweden were very similar. These findings suggest that larger shares of the current birth cohorts in these countries have postponed childbirth rather than remaining permanently childless. The changes in the scale parameter and the proportion of women having children influenced the current increase in the EYWC of these countries to a lesser extent.

In addition, in the Netherlands (1955–1960) and Sweden (1960–1965), the value for the scale parameter in the most recent birth cohort was negative, which implies that the proportions of women having a first child increased in those periods. The negative value of the scale factor in Sweden is consistent with the current decrease in the proportion of childless women (Persson 2010; Miettinen et al. 2015). The higher

Figure 3:
Decomposition of the change over time in females' expected years without children in eight countries



Note: scale: the proportion of the cohort eventually having a child; location: the mean age at first birth; and variance: the standard deviation of age at first birth.
Source: Authors' calculations using the Human Fertility Database.

educational category has a more distinct decreasing trend (Persson 2010). Therefore, this negative value could be mainly driven by women in a higher educational group.

However, the trends in Japan and Portugal differ from those in the other countries. The scale parameter, which indicates the proportion of women who eventually have a child, is the most influential factor in the changes in the EYWC in these countries after 1955 and 1959, respectively. For instance, Table 1 shows that 62% of the change in the EYWC in Portugal from 1959 to 1964 can be attributed to the scale parameter, which means that the shift was mainly attributable to women remaining

permanently childless. Likewise, in Japan, the increase in EYWC was mainly due to the changes in the scale parameter, even though the location parameter had only approximately half as much impact on the latest change. This result indicates that in these countries, more women remained permanently childless than postponed

Table 1:
The contribution of three parameters (scale: the proportion of the cohort eventually having a child, location: the mean age at first birth, and variance: the standard deviation of age at first birth) to the changes in females' expected years without children over time ($_{35}\dot{e}_{15}(t)$) in eight selected countries

Country	Birth cohort	$_{35}\dot{e}_{15}(t)$	Scale	Location	Variance	Sum of all components
Canada	1940–1945	0.2685	0.0957	0.1698	0.0029	0.2684
			(35.66)	(63.26)	(1.08)	
	1945–1950	0.2535	0.1558	0.0951	0.0026	0.2535
			(61.46)	(37.51)	(1.03)	
	1950–1955	0.2129	0.1059	0.1027	0.0043	0.2129
			(49.74)	(48.24)	(2.02)	
	1955–1960	0.2164	0.0497	0.1597	0.0070	0.2164
			(22.97)	(73.80)	(3.23)	
Czech Republic	1940–1945	0.0943	0.0963	−0.0020	0.0000	0.0943
	1945–1950	−0.0845	−0.0844	−0.0001	0.0000	0.0845
	1950–1955	−0.0253	0.0311	−0.0565	0.0000	−0.0254
	1955–1960	0.0651	0.1012	−0.0361	0.0000	0.0651
	1960–1965	0.0473	0.0278	0.0195	0.0000	0.0473
			(58.77)	(41.23)	(0.00)	
Japan	1955–1960	0.3232	0.1968	0.1276	−0.0011	0.3232
	1960–1965	0.3749	0.1923	0.1875	−0.0048	0.3750
Netherlands	1940–1945	−0.0789	0.0094	−0.0883	0.0000	−0.0789
	1945–1950	0.2709	0.1536	0.1186	−0.0013	0.2709
	1950–1955	0.3247	0.0594	0.2695	−0.0041	0.3249
	1955–1960	0.2205	−0.0158	0.2395	−0.0031	0.2206
Norway	1952–1957	0.2856	0.0790	0.2045	0.0021	0.2856
			(27.66)	(71.60)	(0.74)	
	1957–1962	0.1951	0.0368	0.1582	0.0002	0.1952
			(18.85)	(81.05)	(0.10)	
Portugal	1944–1949	0.1611	0.2075	−0.0462	0.0003	0.1615
	1949–1954	−0.1796	−0.0996	−0.0803	0.0003	−0.1796
	1954–1959	−0.0823	−0.0606	−0.0216	0.0001	−0.0824
	1959–1964	0.3192	0.1980	0.1205	0.0007	0.3192
			(62.03)	(37.75)	(0.22)	
Sweden	1955–1960	0.2611	0.0578	0.2037	−0.0002	0.2613
	1960–1965	0.0485	−0.0173	0.0643	0.0015	0.0485

Continued

Table 1:
Continued

Country	Birth cohort	${}_{35}\dot{e}_{15}(t)$	Scale	Location	Variance	Sum of all components
US	1943–1948	0.2785	0.1422 (51.08)	0.1202 (43.18)	0.0160 (5.75)	0.2784
	1948–1953	0.3082	0.1131 (36.78)	0.1376 (44.75)	0.0568 (18.47)	0.3075
	1953–1958	0.0902	0.0007 (0.78)	0.0578 (64.08)	0.0318 (35.25)	0.0902
	1958–1963	0.0667	0.0077 (11.54)	0.0455 (68.22)	0.0136 (20.39)	0.0667

Note: Percentages are presented under each value in parentheses and are calculated only when all terms go in the same direction. The sum of all components (scale, location, and variance) varies slightly from the difference in the expected years without children (${}_{35}\dot{e}_{15}(t)$) due to rounding the numbers to the third decimal point in the table.
Source: Authors' calculations using the Human Fertility Database.

their first birth to a later age. For Japan, the strong linkage between marriage and childbearing may be the key to understanding the large impact of the scale factor. As the nonmarital birth rate in Japan is still at a low level – i.e., 2.29% in 2015 (National Institute of Population and Social Security Research 2017) – most births in that country occur in marital unions. Hence, the large influence of the scale factor in Japan may indicate that the never-married population in Japan is increasing. Indeed, between 1980 and 2015, the never-married population at age 50 increased from 2.6% to 23.4% for males and from 4.5% to 14.1% for females (National Institute of Population and Social Security Research 2017). In Japan, the shares of never-married people are almost equal to the shares of childless people. This explains why the scale factor plays a larger role in Japan than in the other countries. Interpreting the findings for the Czech Republic is difficult because its EYWC trend fluctuated.

The changes in the variance parameter were not found to be influential in the changes in the EYWC in any of the countries in our sample except the US. The much larger variance effect observed in the US may be attributable to the strong differentials in first birth behaviours by indicators of socio-economic status, such as educational level, union status, and race/ethnicity. Rendall et al. (2010) found that in the US, there has been a persistent trend of early first births among low-educated women, and a shift towards later first births among women with higher educational levels. Moreover, Chandola et al. (2002) suggested that this heterogeneity is related to marital status, with an early bulge linked to extra-marital births, often among solo mothers. They also argued that ethnic differences play an important role in explaining the variance in the first birth trends in the US. Likewise, Kostaki and Paraskevi (2007) linked the observed heterogeneity in first birth patterns in the US

to a range of fertility determinants, including the rise of migrant populations in conjunction with racial and ethnic differences.

Overall, the results strongly indicate that changes in EYWC are mainly due to two factors: remaining permanently childless and postponing childbirth. Except in the US, the variability in the timing of childbirth is generally not found to be a factor in the changes in EYWC.

4 Conclusion

Increases in the proportion of childless women, the mean age at first birth, and the variance in the timing of the first birth have been observed in high-income countries (Kohler and Philipov 2001; Kreyenfeld and Konietzka 2017; Mills et al. 2011). These increases have led researchers to ask an important question: Which of three effects – remaining permanently childless, postponing the first birth, or the expansion of the standard deviation of the mean age at first birth – has the most impact on the changes in the first birth trend?

We used cohort data for eight high-income countries from the Human Fertility Database (HFD) and applied the decomposition method developed by Mogi and Canudas-Romo (2018) to quantify the effect of the aforementioned components on the changes in Expected Years Without Children (EYWC) over time. Our analysis of the trends showed that the EYWC in Canada, the US, the Netherlands, Japan, and Norway increased steadily across cohorts. In Sweden, EYWC increased until the 1960 birth cohort, and then remained at the same level. In Portugal, the EYWC increased starting with the late 1950s cohorts after fluctuating. In the Czech Republic, no clear EYWC trends across cohorts could be observed. The decomposition results strongly indicate that changes in EYWC are mainly due to two factors: remaining permanently childless and the postponement of childbirth. The findings of the decomposition analysis show that in Canada, the US, the Netherlands, Sweden, and Norway, more people postpone the first birth to a higher age than remain permanently childless. In these countries, the EYWC has an increasing trend mainly because their female populations have delayed childbirth. This could be the result of improvements in female education and labour force participation and better access to effective contraceptive methods. By contrast, in Japan and Portugal, more women remain permanently childless than postpone childbirth. The strong link between marriage and childbirth in Japan may be an important key to understanding the large impact of the scale factor in that country (National Institute of Population and Social Security Research 2017). For all periods and for all of the countries analysed except the US, the variance factor did not have a large impact on the changes in EYWC. This might be due to the greater heterogeneity in the first birth trend by socio-economic status in the US compared to in other countries (Chandola et al. 2002; Kostaki and Paraskevi 2007; Rendall et al. 2010).

Finally, in future research, this decomposition method could be applied to subpopulations, such as educational groups. It is well known that the timing of first

birth and the share of childless women differ significantly by education (Beaujouan et al. 2016; Kneale and Joshi 2008). Applying this method to union status (e.g., single, cohabitation, married) and race/ethnicity would also be beneficial.

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Appendix A: The statistical test of the CM model

We conducted a statistical examination of the CM model using the Kolmogorov-Smirnov test (KS test). The KS test is a nonparametric test to check the goodness-of-fit of the observed distribution and the estimated one by the CM model. The test statistic D of the KS test quantifies the supremum distance between the empirical distribution function of the data and the cumulative distribution function of the CM distribution. The null distribution of this statistic is calculated under the null hypothesis that the data follow the CM distribution. Thus, a p-value greater than $\alpha = 0.05$ indicates that the data and the CM model have a good fit. As Table A.1 shows, the CM model estimated the observed data statistically well for all countries and birth cohorts.

Table A.1:
Goodness-of-fit of the CM model using the Kolmogorov-Smirnov test

Country	Birth cohort	D	P-value	Country	Birth cohort	D	P-value
Canada	1940	0.1429	0.8745	Norway	1952	0.1429	0.8674
	1945	0.1714	0.6902		1957	0.2000	0.4858
	1950	0.1714	0.6902		1962	0.1714	0.6902
	1955	0.1714	0.6902	Portugal	1944	0.2000	0.4916
	1960	0.1714	0.6902		1949	0.1429	0.8674
Czech Republic	1940	0.1143	0.9794		1954	0.1143	0.9763
	1945	0.1429	0.8674		1959	0.1143	0.9794
	1950	0.1143	0.9763		1964	0.1714	0.6902
	1955	0.0857	0.9995	Sweden	1955	0.1714	0.6902
	1960	0.1143	0.9763		1960	0.1714	0.6902
	1965	0.1143	0.9763		1965	0.1429	0.8745
Japan	1955	0.1143	0.9794	US	1943	0.1143	0.9794
	1960	0.1143	0.9794		1948	0.1429	0.8745
	1965	0.1714	0.6902		1953	0.1714	0.6902
Netherlands	1940	0.1714	0.6826		1958	0.1714	0.6902
	1945	0.1143	0.9763		1963	0.1714	0.6902
	1950	0.1429	0.8745				
	1955	0.2000	0.4916				
	1960	0.1714	0.6826				

Source: Authors' calculations using the Human Fertility Database.

Appendix B: Calculation process: Expected years without children

The life expectancy from age zero to age X is shown as

$$ {}_{X}e_0(t) = \int_0^X l_{x,t}\, dx. $$

We call the life expectancy between age 15 and age 50 the expected years without children (denoted ${}_{35}e_{15}(t)$). It is formulated as follows:

$$ \begin{aligned} {}_{35}e_{15}(t) &= \int_{15}^{50} l_{x,t}\, dx \\ &= 35 - \int_{15}^{50} F_{x,t}\, dx, \end{aligned} $$

where l_x is the probability of remaining childless and F_x is its cumulative probability function. The detailed calculation procedure can be found in Mogi and Canudas-Romo (2018).

Appendix C: The decomposition to discrete data

Three parameters of f_x are estimated using the maximum likelihood estimation method, as suggested by Rodríguez and Trussell (1980):

$$ \text{lnLH} = \sum_{15}^{49} (\text{With}_x \log[F_{(x+0.5)}] + \text{Without}_x \log[1 - F_{(x+0.5)}]), $$

where With_x is the female population with children at age x, Without_x is the female population without children at age x, and F_x is the cumulative probability function at age x.

Vaupel and Canudas-Romo (2003) and Bergeron-Boucher et al. (2015) applied the continuous decomposition equation to discrete time data, and we followed their method. To estimate each function by applying our decomposition method to discrete time data, we use the midpoint over a time interval (Preston et al. 2001). As Mogi and Canudas-Romo (2018) assumed for the nuptiality decomposition, an exponential change assumption is used for the functions except EYWC, and the midpoint of EYWC is assumed to be a linear change in the interval. The details can be found in Mogi and Canudas-Romo (2018).

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What factors support the early age patterns of fertility in a developing country: the case of Kyrgyzstan

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Abstract

We analyse the socio-economic and cultural factors that influence the timing of the first birth in Kyrgyzstan. As in several other developing countries in Central Asia, no trend towards the postponement of fertility has been observed in Kyrgyzstan. This contrasts not only with the current trend towards later parenthood that has been documented in highly developed countries, but with an incipient trend towards a delay in the timing of the first birth that has been reported in many developing countries. Our study is based on the Multiple Indicators Cluster Survey – 2014 (MICS2014), with complementary data drawn from the Demography and Health Survey – 2012 (DHS2012). Our analysis of the first union and of the first birth in a union for cohorts of women born between 1965 and 1998 showed that the rates of union formation and motherhood have increased among the younger cohorts. We also found that a woman's education, labour market experience, and the gender relations in her family influenced her likelihood of transitioning to a first union and to motherhood. In addition, we uncovered significant differences in the timing of motherhood and union formation between women of different ethnicities, and looked at the factors that may have contributed to these differences. The factors that support a stable age pattern of fertility in Kyrgyzstan are of interest when conducting broader comparative research on fertility timing in developing countries, as these factors may help explain the current diversity in these patterns.

Keywords: fertility timing; fertility postponement; age at first birth; developing countries; Central Asia

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1 Introduction

Issues surrounding fertility timing and how it is changing have attracted considerable attention in demographic research. In the highly developed countries, fertility postponement is considered as one of the central demographic trends of recent decades that are associated with the "Second Demographic Transition" (Lesthaeghe 2010). In developing countries, trends in fertility timing have been less clear. In a study of a large sample of developing countries in the 1980–1990s, Bongaarts (1999) found an increasing trend in the mother's mean age at first birth (MAB1). Bongaarts et al. (2017) confirmed this general tendency for more recent decades, and argued that it has been related to growth in educational levels in the developing world. However, studies for individual developing countries have suggested that the timing trends in the transition to motherhood have varied considerably since the turn of the century (see Section 2). In some developing countries, the age patterns of fertility have remained stable even though total fertility has fluctuated, whereas in other developing countries, fertility has even undergone a "rejuvenation". This makes the question of what factors have been influencing fertility timing in developing countries especially relevant.

In this study, we consider this question mainly by examining the influence of economic and cultural factors while focusing on Kyrgyzstan, a post-Soviet country in Central Asia. This case study is of broader interest for two reasons. First, like other countries in Central Asia, Kyrgyzstan has not experienced a trend towards first birth postponement. Second, the country has a multi-ethnic character, and the considerable socio-economic and cultural differences between its ethnicities also affect their union formation and childbearing patterns. The research on ethnic diversity in family behaviour has a wider relevance, as ethnicity is an important differentiating factor in demographic behaviour in many developing countries.

The paper is organised as follows. Section 2 gives an overview of recent research on the timing of fertility in developing countries, and outlines our hypotheses regarding the factors that influence the MAB1 in these countries. Section 3 provides basic information on social development and fertility trends in Kyrgyzstan, focusing on the post-Soviet period. Section 4 outlines the data we used, and Section 5 presents an analysis of first union and first birth timing in relation to selected economic and cultural factors. Since levels of out-of-union fertility are extremely low in Kyrgyzstan, the analysis of first births can be decomposed into two distinct processes: the entry into the first union and the transition to motherhood within a first union. Therefore, we have chosen to run separate Cox regression models for the risks of these two events. In section 6, we discuss the results of our analysis, and conclude.

2 Timing of the first birth in developing countries: background and hypotheses

Fertility postponement has been studied in detail, especially for the countries of Europe and North America (see Billari et al. 2007; Sobotka 2010; Mills et al. 2011, among many others). Most studies on this topic conceptualised first birth postponement as a shift in the MAB1 to higher ages. We follow this concept in this study.

Fertility postponement was occurring in most countries of Europe between the 1960s and 1990s. In the "Western world", fertility postponement is often linked to an ideational shift towards higher levels of individual autonomy, gender equality, and a focus on "higher order needs". The changes in family behaviour associated with this shift are commonly referred to as the "Second Demographic Transition" (SDT; see Van den Kaa 1987; Lesthaeghe 2010). In addition, the sharp growth in women's tertiary education has been identified as a key driver of fertility postponement in highly developed countries (see Ní Bhrolcháin and Beaujouan 2012; see also Billari and Philipov 2004 for an earlier discussion). By contrast, in Central and Eastern Europe, fertility postponement started two or three decades later, typically in the 1990s, when the collapse of state socialism led to serious political turbulence and economic hardship. It has been speculated that in these countries, the insecurity of young adults, rather than an SDT-style ideational change, was mainly responsible for the start of fertility postponement trends and the decrease in desired fertility (Philipov et al. 2006). Another explanation for the levels of fertility postponement that occurred in Eastern European and some Central European countries after the collapse of state socialism is that they were driven by institutional changes. For example, Ní Bhrolcháin (1993) and Speder (2005) argued that housing regulations supported early fertility under state socialism, because the birth of a child increased dwelling density, and thus increased a family's chances of being granted a larger dwelling by the authorities. Thus, the shortage of housing was a very important factor in early fertility under state socialism, but it became irrelevant as soon as the housing regulations changed in the early 1990s. Although considerable evidence has been provided that supports these economic explanations for the fertility postponement trends in Eastern Europe, value-oriented explanations for this phenomenon have also been widely discussed (Sobotka 2008).

Trends in fertility timing in developing countries continue to be much more poorly documented than trends in Europe. A systematic analysis of MAB1 trends for a large and geographically diverse group of developing countries was conducted by Bongaarts (1999) using data from the DHS and WFS surveys for the last decades of the 20th century. His conclusion was that during that period, the MAB1 was generally increasing across the developing countries he considered. In a more recent paper, Bongaarts et al. (2017) examined the trends in first intercourse, first marriage, and first birth timing among women in 43 developing countries of Asia and North

Africa, Latin America and the Caribbean, and sub-Saharan Africa based on DHS survey data from these countries, which were collected mainly between 1993 and 2010. The results indicated that the ages at first marriage and at first birth were increasing in most of these countries during the period under study. The authors argued that this age shift was primarily due to the expansion of girls' school participation, and that the increases in these ages would have been much more modest if the average educational level of women in the developing countries under study had not changed.

We are not aware of other recent comparative studies of MAB1 dynamics in developing countries. The failure to conduct such studies may be partly explained by a lack of satisfactory data. In addition to being considered rather unreliable, the official statistics on developing countries often contain no information on mothers' mean ages by parities, and calculating MAB1 from survey data can be difficult (Multrie et al. 2012).

Under these conditions, it has been suggested that fertility timing trends in developing countries could be approximated based on age-specific fertility rates (ASFRs), which are normally available from official statistics or from survey data. However, as ASFRs show the age distribution of births of all orders, the MAB1, which our analysis focuses on, cannot be computed from ASFRs. Nonetheless, in the descriptive part of this study, we will mainly follow ASFRs, as the age-specific fertility rate is the most readily accessible indicator of fertility timing trends. If the timing of the first birth has shifted between the age groups for which ASFRs are available (normally five-year age groups), we would expect to find that the proportions between the ASFRs of the relevant age groups have changed. Specifically, if the transition to motherhood has shifted to older ages, the ASFR of a younger age group among whom the first births were concentrated before the transition would have become smaller than the ASFR of the subsequent age group among whom the number of first births per woman had grown. If, by contrast, the timing of the transition to motherhood has shifted to earlier ages, a reverse change would be expected, with a younger ASFR becoming closer to or even overtaking the neighbouring older ASFR. It should, however, be noted that if total fertility is decreasing, it is possible that a younger ASFR proportion is growing more than an older ASFR proportion even when higher order births in the older age group are decreasing, but first birth fertility remains high and is still concentrated in the younger age group; i.e., the timing of the transition to motherhood remains stable while total fertility is decreasing. Therefore, an increase in the inputs of the ASFRs of younger age groups to total fertility do not unambiguously point to a decrease in the MAB1. Finally, when the proportions of ASFRs remain stable, it is safe to assume that the peak of first births is not moved from one age group to another. Given that in most developing countries, the mean age at first birth is below 30, it may be assumed that changes in the age at first birth that move its peak between five-year age groups affect the relative proportions of the five-year ASFRs more for the 15–19, 20–24, and 25–29 age groups than for the older age groups. Therefore,

we will concentrate below on the relative changes in the ASFRs of these younger age groups.

Studies on individual developing countries that have investigated the ASFR trends have suggested that over the past two decades, first birth postponement has been far from universal in the developing world. Consider, for example, studies on fertility conducted at the beginning of 21st century in some MENA countries. In Algeria, the rise in the TFR from 2.2 in 2000 to 2.7 in 2008, preceded by a dramatic decline in the TFR through the 1970s to the 1990s, was mainly due to an increase in the fertility rate at ages 15–24, which grew more than twice as much as the ASFR at ages 25–29 in that period, and thus came closer to it, but did not exceed it (Ouadah-Bedidi and Vallin 2012). The growth of the youngest ASFRs was mainly due to a shift in the female age at first marriage to younger years, as in populations in which childbearing after marriage is considered almost obligatory, an increase in the age at first marriage normally also results in an increase in first births at those ages. A similar trend can be observed in Egypt, where a rise in total fertility from 3.0 in 2008 to 3.5 in 2014 was accompanied by a change in age patterns, with the fertility peak shifting from ages 25–29 to ages 20–24 over that period (Al Zalak and Goujon 2017). Note that since in both Algeria and Egypt total fertility was increasing with the shift in timing, there is no reason to assume that the growth in the proportion of the youngest age groups relative to the proportion of the 25–29 age group was due to a decrease in higher order births in the latter age group. For another MENA country, Jordan (Cetorelli and Leone 2012), it has been observed that the recent ASFRs trends have not pointed to a shift towards an earlier entry into motherhood, but they have not pointed in the opposite direction either. In Jordan, multidirectional changes in the TFR occurred after 2002: i.e., the TFR declined from 4.4 in 1997 to 3.6 in 2007, and then rebounded to 3.8 in 2014, under a rather stable age distribution of fertility that reached its peak at ages 25–29. In one more country with a TFR above the replacement level, Bangladesh, a fertility decline from 3.3 in 1996/97 to 2.7 in 2007 proceeded while the ASFR proportions remained stable, with fertility reaching its peak at ages 20–24 (Kamal 2010).

In the present paper, we do not study the question of how frequent the different timing trends observed in recent decades across developing countries are, or how they are related to changes in total fertility. Instead, we turn to the question of what socio-economic and cultural factors have been influencing the timing of first birth fertility in a developing country. This question has been addressed in some earlier studies on MAB1 in selected developing countries (e.g., Rindfuss et al. 1983). However, in connection with the timing phenomena of more recent years, this issue is very understudied. We consider the influence of different factors on first birth timing in Kyrgyzstan (Central Asia). There are several reasons why we focus on this country in our study. First, the preliminary evidence suggests that recent trends in reproductive behaviour in Kyrgyzstan do not involve fertility postponement. Although there are no existing ASFRs-based studies on first birth timing in Kyrgyzstan, Spoorenberg (2013) found that the TFR in the country may

have risen in recent decades because of a fertility shift to younger ages.[1] Second, the total fertility dynamics over the past 10–15 years in Kyrgyzstan have been similar to those of the developing countries without fertility postponement mentioned above, as Kyrgyzstan also experienced a decrease in total fertility without reaching the replacement level, followed by an increase in the TFR. Given the similarities in these quantum trends, it makes sense to investigate whether the timing trends were similar as well. Although the treatment of only one country cannot, of course, be the basis for cross-national generalisations, our study can give possible directions for further research on the underlying reasons for the current diversity in fertility timing observed among developing countries.

At least three groups of socio-economic and cultural parameters have been discussed in the current literature as having potential relevance for first birth timing in developing countries. The first group of parameters concerns women's education (see above on Bongaarts et al. 2017) and labour market opportunities. In the studies for individual developing countries that found evidence of fertility postponement, the role of improvements in education was often cited. For example, education was found to influence fertility postponement in Indonesia by Breierova and Duflo (2004), and both education and labour market position were shown to influence fertility postponement in Uruguay by Nathan et al. (2016). By contrast, for some countries that have not been experiencing fertility postponement in recent decades, it has been argued that high levels of fertility among the youngest age groups have been supported by social conditions under which women either had poor labour market prospects or were not motivated to take a job (Al Zalak and Goujon 2017 for Egypt).

Second, first birth fertility can be related to the degree to which gender and generation asymmetries are emphasised in family relations. It has, for example, been argued by Mason (2001), McDonald (2000) and Lerch (2013) that the empowerment of older over younger generations and of men over women within the family – both of which are very common phenomena in many developing countries – may be related to higher fertility. Most of the studies on this topic have concentrated on fertility quantum rather than on timing. However, analyses of certain country-specific data have suggested that more strict gender and generation asymmetries correspond to a younger female age at first marriage, which in developing countries is usually closely related to the age at first birth (cf. Dyson and Moore 1983 for India; see also Carmichael 2011 on the relationship between family organisation and the age at first marriage in a sample of less developed countries). There are several reasons to expect that women and younger generations having subordinate positions in the family can influence fertility timing. First, the empowerment of elders can put social pressure on young women to follow the fertility patterns of preceding generations, including in terms of timing (see Bongaarts and Watkins 1996 on the

[1] Spoorenberg (2013) pointed to the possibility of both a lowering of the MAB1 and a shortening of interbirth spacing. The procedure he used does not allow us to distinguish between the two phenomena.

role of social pressure in fertility behaviour). Second, in some societies with strict gender asymmetries, childbearing is the main way for a woman to achieve a high social position (Salway 2007). Thus, in such situations, a woman may be motivated to become a mother as soon as possible.

Third, ethnicity or religious affiliation can play a significant role in first birth timing. This expectation is based on studies that found evidence of first birth timing differences between ethnic or religious groups in developing countries. For example, Fazle Rabbi and Imrul Kabir (2013) argued that first birth timing differs significantly between Muslim and non-Muslim women in Bangladesh; see also Ngalinda (1998) for a similar conclusion in Tanzania. Rindfuss et al. (1983) found that both religion and ethnicity played a role in the mother's age at first birth in developing countries of South-East Asia. Since these differences remained significant when socio-economic parameters were controlled for, it can be argued that religion and ethnicity may influence the dynamics of first birth timing.

Against this background, in the present paper, we study the following hypotheses on the timing of the first birth in developing countries.

Hypothesis 1. A woman's age at first birth is positively related to her educational and labour market opportunities.

Hypothesis 2. A woman's age at first birth is negatively related to parameters that point to strict gender and generation asymmetries in family relations.

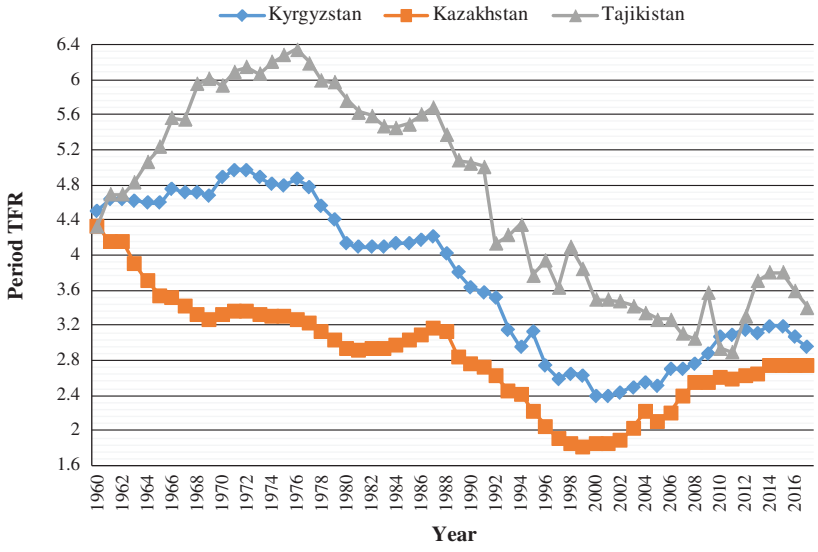
Hypothesis 3. In a multi-confessional and multi-ethnic country, the age at first birth can differ significantly among women with different ethnicities or religious affiliations, even after controlling for key socio-economic parameters.

3 Kyrgyzstan: key facts on population and fertility

Like most other post-Soviet countries, Kyrgyzstan, which had a total population of 6.3 million in 2018, experienced a dramatic decrease in fertility after the collapse of the Soviet Union (1991), which was followed by an increase in fertility in the 2000s (see Figure 1 for a comparison of the TFR dynamics of Kyrgyzstan with the trends of some of its neighbours). The decrease in the 1990s can be regarded as a final stage of the decline in fertility that started as early as in the 1970s following a peak reached in the 1960s. This decline was typical for countries undergoing the First Demographic Transition, but it did not reach the replacement level (TFR = 2.1), which marks the final stage of that transition. The current TFR in Kyrgyzstan is higher than that of its northern neighbour Kazakhstan, but it is lower than that of Tajikistan, the fertility "champion" in Central Asia.

Official data on fertility timing in Kyrgyzstan are available from the yearbooks that can be accessed at the official site of the National Statistical Committee of the

Figure 1:
Period TFR in Kyrgyzstan, Kazakhstan, and Tajikistan, 1960–2017



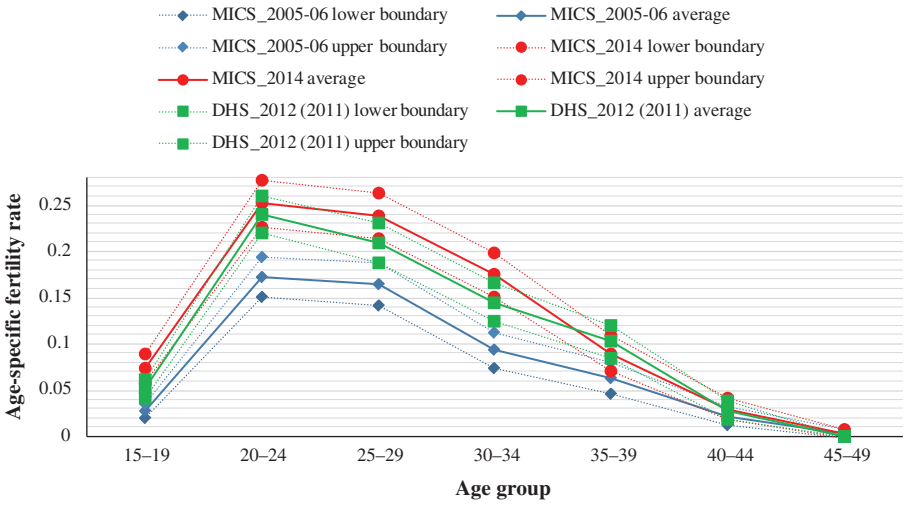
Source: Based on data available at: http://www.demoscope.ru/weekly/ssp/sng_tfr.php

Kyrgyz Republic.[2] According to this source, the MAB1 was stable in Kyrgyzstan in the 2010s, averaging 23.0 years in 2012–2016 and 22.9 years for both 2017 and 2018. The ASFRs based on census data demonstrate that the proportions of age groups in total fertility were also quite stable between 1989 and 2009, with the ASFR remaining the highest for the 20–24 age group (Denisenko et al. 2012). In Figure 2, the ASFRs based on the data from the major sample surveys carried out in Kyrgyzstan between 2000 and 2015 are plotted (see the next section for some remarks regarding the accuracy of survey data on Kyrgyzstan). Again, it can be seen that the age distribution of fertility remained quite stable during this period, with no shift in the fertility peak from the 20–24 age group to the older age groups. (Note that since total fertility was growing for most of the time period between the surveys, it is unlikely that the finding that the proportion of fertility was highest in the 20–24 age group was due to a decrease in fertility in the older groups because of a decrease in higher order births).

The share of fertility that occurred outside of registered marriage amounted to 21.5% in 2018 (it varied between 16.1% and 29.4% from region to region). However, as the survey data show very low proportions of births outside of actual unions, the

[2] http://stat.kg/en/publications/demograficheskij-ezhegodnik-kyrgyzskoj-respubliki/

Figure 2:
Age-specific fertility rates (ASFR) in Kyrgyzstan, selected surveys 2005–2014 (with 95% confidence intervals)



high levels of fertility outside of registered marriage may be explained by a lack of civil registration of unions that had been confirmed under religious law.

Kyrgyzstan is a multi-ethnic country. Its main ethnic groups are Kyrgyz (making up 71% of the population according to the 2009 census, and 73.5% of the population according to the administrative sources for 2018), Uzbeks (14.3%/14.7%), and Russians (7.8%/5.5%). Most Kyrgyz and Uzbeks are Muslims, and most Russians are Orthodox Christians. Like the other former Soviet Republics of Central Asia, Kyrgyzstan experienced a sizable out-migration after 1991, with ethnic Russians being especially likely to leave the country (Tishkov 1994). The other ethnic groups present in Kyrgyzstan are heavily involved in temporary labour migration, mainly to Russia. A migration survey conducted in Kyrgyzstan in 2018 reported that more than 700,000 Kyrgyzstan citizens were registered in other countries, including 640,000 in Russia (State migration service under the Kyrgyzstan government, 2019). Russian statistics for 2016 have reported that the country was hosting 360,000–400,000 labour migrants from Kyrgyzstan (10% of all labour migrants coming to Russia). It is noteworthy that the proportion of migrants from Kyrgyzstan to Russia who are women has been about 40% in recent years, which is higher than it has been among most of other migration flows targeting Central and Eastern Europe (FIDH 2016).

Kyrgyz and Uzbeks occupy different areas of the country, with Uzbeks mainly concentrated in the south. Although a revival of Islamic religious practices has been a general trend in Kyrgyzstan and in other post-Soviet countries of Central

Asia since the collapse of the Soviet Union, it has been observed that among local Uzbeks, the social role of Islam is larger, and its forms are more "radical" according to certain definitions (cf. Tromble 2014). The level of urbanisation is highest among Russians, a majority of whom have been living in urban areas since the Soviet era. The educational levels in Kyrgyzstan have remained rather stable in the post-Soviet period according to census data, as the proportion of people with high (tertiary) education among those older than age 15 was 11.0% in 1989, 10.5% in 1999, and 12.4% in 2009 (Census data available from http://www.demoscope.ru/weekly/ssp/sng_chi_89.php). Currently, according to the National Statistics Office, tertiary education has been declining somewhat, mainly due to the liquidation of universities outside of the capital of Bishkek. The number of university students in the country's population decreased from 43,000 in the 2012/2013 academic year to 30,000 in the 2016/2017 academic year.

When we look at the gender and generational relations of post-Soviet Kyrgyzstan, we see that many traditional asymmetries have been preserved that empower men over women and older over younger generations. In part, these asymmetries were strengthened by post-Soviet "nation-building" propaganda calling for a return to patriarchal family relations (Kandiyoti 2007). Ismailbekova (2016) has shown that families remain strictly patrilocal, with housekeeping obligations being mainly imposed on wives. Generation asymmetries are manifested in, for example, the subordination of young wives to the parents and elder relatives of their husbands. Although the traditional family norms are currently being challenged by the intensive labour migration of the male population, which makes the role of women more decisive in many family questions (Ismailbekova 2014), these norms currently remain dominant in the family relations of the native peoples of Kyrgyzstan.

Several studies have addressed fertility trends in post-Soviet Kyrgyzstan. Spoorenberg (2015), considered possible explanations for the recent increase in the TFR in the countries of Central Asia, and argued that timing changes could be among them. He found that in Kyrgyzstan, the growth in the observed TFR was accompanied by downward movement of the tempo-adjusted TFR (Bongaarts and Feeney 1998) in the first half of the 2000s. This pattern signals that a tempo shift towards younger fertility conditioned the TFR growth. In the second half of the 2000s, the observed and the adjusted TFRs were increasing in parallel in Kyrgyzstan, which allows us to conclude that at that time, quantum growth contributed to the growth of the observed TFR together with the shift to earlier timing. Importantly for the purposes of our study, the comparison of the observed and the tempo-adjusted TFR provides evidence that fertility postponement did not occur in Kyrgyzstan in the 2000s, because in the postponement situation, the adjusted TFR would be expected to show dynamics that are more positive than those found in Kyrgyzstan. Inputs of different parities to the fertility increase in Kyrgyzstan were considered by Spoorenberg (2017), who concluded that the TFR growth in the 2000s was mainly due to increases in the first and second parities that took place in all ethnic groups.

The impact of ethnicity on fertility in Kyrgyzstan between 1990 and 2005 was studied by Nedoluzhko and Andersson (2007). They found that the risk of entry

into first parenthood was lower among Russians living in Kyrgyzstan (whom they categorised as "Europeans" together with other peoples of European origin, such as Ukrainians) than among native-speaking representatives of Turkic ethnicity (Kyrgyz, Uzbeks), but also that the risk was still significantly lower among Russian-speaking representatives of Turkic peoples than among Europeans. In a comparison of fertility trends among the major ethnic groups of Kyrgyzstan and Kazakhstan between the middle of the 1990s and the middle of the 2000s, Agadjanian et al. (2013) showed that how the fertility levels of the ethnic groups reacted to the economic growth of the 2000s had no direct correspondence to their rankings in terms of absolute fertility levels, as only the fertility levels of Russians – the least fertile ethnic group – grew much more in the mid-2000s than in the mid-1990s. The authors explained this finding by noting the lower base of fertility of Russians before the start of the period of economic growth in both countries, and by citing selectivity effects, whereby Russians who did not leave Central Asia probably were better adapted to local realities than their co-ethnics who preferred to leave the country.

In the countries of Central Asia, ethnic and cultural differences have been reported not only for fertility, but for union formation patterns. Thus, Agadjanian and Dommaraju (2011) argued that in Kyrgyzstan, the probability of entering an unregistered cohabitation is highest among European women, lower for Russified Kyrgyz women, and still lower for non-Russified Kyrgyz women; whereas the probabilities of entering a registered marriage are in the reverse order for the three groups of women. This implies that the more pronounced "traditionalism" in couple formation is related not just to the ethnicity, but to the cultural background of women (this is even more the case for men, among whom the gap in the probability of entering cohabitation is even greater between Russified and non-Russified Kyrgyz than between Europeans and Kyrgyz). It should be noted that the label of cohabitation (unregistered marriage), which is used in both census and survey results, can conceal very diverse phenomena in Kyrgyzstan, ranging from "European-style" cohabitation to Islamic marriage without state registration. According to Denisenko et al. (2012), the growth in marriage rates in Kyrgyzstan between 1999 and 2009 left the proportion of unregistered marriages at a stable level of about 8%. Among ethnic Russians, most of whom are not Muslims, and among whom religious sources of unregistered marriage are less probable, that proportion was nearly twice as high as it was among Kyrgyz. A very high propensity for marriage among pregnant women in Kyrgyzstan was reported by Nedoluzhko and Agadjanian (2010), which suggests that the acceptance of out-of-union births in the country is low.

The data considered in this section may provide evidence of the stability of fertility timing in light of our hypotheses in Section 1. Specifically, the finding that educational levels in the country are stable would be in line with the lack of fertility postponement shown by official statistics (Hypothesis 1). The differences in religious affiliation found between Russians on the one hand and Kyrgyz and Uzbeks on the other indicate that the timing trends can differ between different

ethnicities. Timing differences between Uzbeks and Kyrgyz can also be expected because they represent different ethnicities, and possibly because of differences in their religious and cultural practices.

4 Data

Two representative surveys were used in our analysis: the Multiple Indicators Cluster Surveys conducted in 2014 (MICS2014) and the Demography and Health Survey conducted in 2012 (DHS2012). Both surveys covered a national-level representative sample of women aged 15–49. The MICS2014, conducted between April and June 2014, covered 6854 women. The DHS was conducted between August and December 2012, and had 8208 women in its individualized record set. According to official reports on these surveys, the response rate for women was 96% in the MICS2014 and 97% in the DHS2012.

Here, we briefly consider the limitations of the data provided by these surveys. First, the survey samples did not include women who were engaged in temporary labour migration. Thus, births that took place in the country to women who had undertaken out-migration before the time of the survey are outside of the scope of the survey data, which could distort both period fertility estimates for past years and age-specific cohort fertility estimates. At the same time, migrants are often already selected for lower fertility in their home country. This is especially likely for those engaged in labour migration, which is typically undertaken by more educated and less family-oriented women. For this reason, the under-registration of the fertility of current migrants in past years is likely to result in a bias towards the fertility indicators having a higher meaning. Note, however, that this bias is not expected to be more pronounced at younger than at older ages. Indeed, the younger an age point is, the more probable it is that future labour migrants were still in the home country by that age at the time of the survey, and, therefore, the less probable it is that the survey fertility indicators were biased because of the under-registration of the in-the-country fertility of future migrants at that age. Thus, crucially for our purposes, we have no reason to expect that the possible under-registration of fertility of future migrants causes a more serious overestimation of fertility at younger than at older ages.[3]

Another limitation is related to the possible under-representation of childless women. It is generally expected that in developing countries, unmarried and childless women may be under-represented in a sample because of the cultural inappropriateness of being unmarried or childless after reaching a certain age (see, e.g., Hull and Hartanto 2009). Note that Spoorenberg (2017) has argued that

[3] Note that the results of the Russian census for 2010 appear to confirm the suggestion that Kyrgyz migrants were selected for lower fertility, as they signal that the completed fertility of real cohorts of Kyrgyz women living in Russia at the time of the census was much lower than that of Kyrgyz living in Kyrgyzstan (not shown here).

childlessness is under-represented to a greater extent in the DHS2012 than in the vital statistics for Kyrgyzstan. When studying first birth timing, relying on incorrect estimates of proportions of childlessness can, of course, result in distortions. Our only option for estimating the under-representation of childless women in the sample surveys was to compare their results with those of other sources for which the omission of this category of women is less likely. We have compared the estimates of the proportions of women who have at least one child at different ages between 15 and 40 from the Kyrgyzstan census for 2009 with those from the DHS2012 and the MICS2014. For the surveys, it was possible to calculate this proportion retrospectively for 2009, as they contain information on the date of the first birth for all of the fertile women in their samples. Indeed, compared to the census, both the MICS and the DHS have reported higher proportions of women having at least one child for some age groups (the results of the comparison are not shown here for reasons of space). It is, however, clear that in both surveys, this underestimation mainly occurs for the 25–29 and older age groups. Given that both surveys show that the peak of first birth fertility was below age 25, we do not expect that this overestimation will seriously distort our analysis of first birth timing based on the survey data.

5 The analysis

In our first analytical step, we compared the cumulative probability of remaining childless by age among neighbouring birth cohorts using survey data from both the DHS2012 and the MICS2014. This comparison allowed us to see whether the cumulative probability of having the first child at different ages changed from one five-year birth cohort to another, starting from the cohort born in 1965–1969 and ending with the cohort born in 1995–1998.[4] We concentrated on a comparison of event risks across cohorts rather than across periods because the cohorts included in the study differed considerably in terms of the social conditions they experienced at the start of their reproductive period. Members of the oldest cohort underwent socialisation and spent a portion of their reproductive period in the Soviet era, while subsequent cohorts started their reproductive period in the post-Soviet turmoil, and the youngest cohorts started their reproductive period in the 2010s. Thus, the cohort analysis allowed us to look at how changes in social experiences influenced the first birth decisions of respondents.

Figures 3 and 4 plot the cumulative probabilities of childlessness at different ages by birth cohort according to data from the DHS2012 and the MICS2014. They do not show a considerable expansion of childlessness towards older ages in the younger cohorts. The lack of such an expansion was confirmed by statistic tests.

[4] The youngest cohort included women with only four years of birth, as those born in 1999 were absent from the DHS2012 sample, and their proportion in the MICS2014 sample was very low.

Figure 3:
Cumulative monthly probability of childlessness from age 15 according to the MICS2014 (women born 1965–1998)

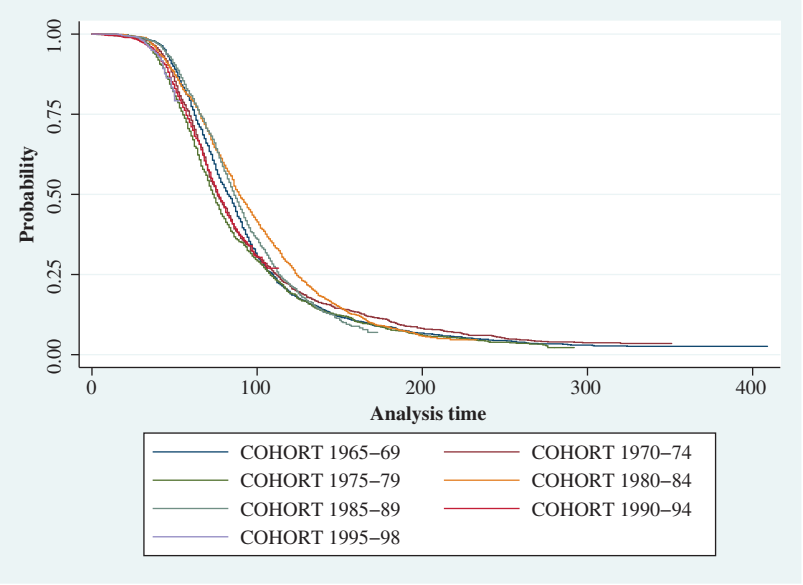
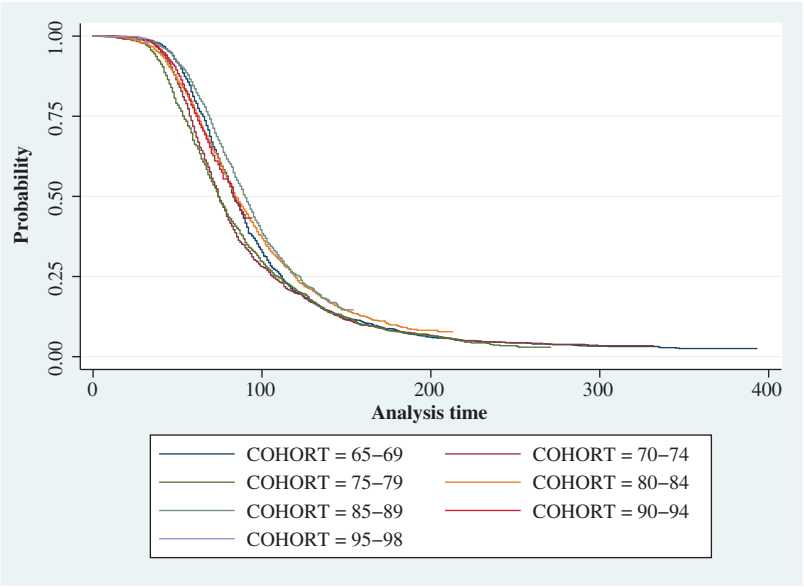


Table A.1 of the Appendix sums up the statistic tests that measured differences in the cumulative probability of remaining childless between neighbouring birth cohorts according to the DHS2012 and the MICS2014; i.e., these tests indicated whether the differences between the cohorts shown in Figures 3 and 4 were statistically robust. Standard tests for a comparison of Kaplan-Meier estimates were used. For each cohort, the cumulative probability of remaining childless was estimated for each month starting from the age of exactly 15 years. There were two cohorts for whom the data from both surveys signalled a significant difference between each cohort and the preceding cohort: these were the cohorts born in 1980–84 and in 1990–94. For the 1980–84 cohort, a postponement of the first birth compared to the timing of the first birth in the 1975-79 birth cohort could be observed (a subsequent recuperation occurred for the 1985–89 cohort according to the MICS2014, but not according to the DHS2012). For the cohort born in 1990–94, the cumulative probability of remaining childless was lower than that for the cohort born in 1985–89 at all ages reached by both cohorts before the time of the survey. Thus, there was only one cohort for whom the Kaplan-Meier analysis showed a postponement of the first birth compared to the timing of the first birth in the preceding cohort, and there was one more cohort for whom the analysis found that the timing of the first birth was earlier than it was in the preceding cohort. Of course, these findings do not allow us to assume that fertility postponement from older birth cohorts to younger cohorts

Figure 4:
Cumulative monthly probability of childlessness from age 15 according to the DHS2012 (women born 1965–1998)



was the dominant trend. Note also that the similarity of the estimations based on the two surveys makes this result more robust.

For a more accurate statistical account of the timing trends, Cox regressions were built for the sample from the MICS2014. We have chosen the MICS2014 data for the regression analysis because they are the most up-to-date survey data that are available to us. Two sets of models were run: one for proportional risks of first union starting from the age of 15 years zero months, and one for the proportional risks of first birth starting from the month of the first union. Studying the risks of first birth only among women who had been in a partnership made sense for Kyrgyzstan, as births outside of a partnership are still very infrequent in that country. In the MICS2014 sample, there were only two women who reported having given birth to a child, but having never been in a partnership. Only 1.1% of women who had a child provided a first birth date that preceded the date of the start of their first partnership (these respondents were not included in the analysis of first birth risks, but given that they made up only a small proportion of the sample, their exclusion was unlikely to distort the results). We identified a number of reasons to follow the somewhat non-standard path of running the two separate sets of models instead of one set of models for the first birth, which could have marital status as a time-varying parameter. First, given that out-of-union fertility is very rare in this context, considering a woman's first birth risks for the period before she entered her first union looked superfluous.

Second, the MICS data did not allow us to assign the marital status to each time period in the life course of each woman in the sample because even though the data contained information on the dates of entry into the first union, it did not specify the dates of divorces or of the deaths of partners. Therefore, the assignment of the time-varying parameter of marital status to divorced/separated women and to widows could produce inaccurate estimates. Finally, the two sets of models allowed us to disentangle the effects of the transition to the first union and to the first birth in a union on first birth fertility, which would have been impossible if only the risks of first birth starting from age 15 were studied.

Importantly, the MICS2014 data supplied information on the age at first union rather than on the age at marriage. This represented a limitation for our analysis, as we were unable to determine whether a child was born in a registered marriage. However, as we mentioned above, unregistered unions became more common in the country in the post-Soviet period. Therefore, it is more appropriate to assume that the start of a first union, rather than the registration of a marriage, was the main precondition for a first birth. Another limitation was that, as we noted above, the MICS data did not allow us to determine how much time a woman spent in her first union if she was divorced/separated or became a widow. However, according to the MICS2014, union dissolution was a relatively infrequent phenomenon, as only 7.5% of women who reported ever having been in a union described themselves divorced or separated at the time of the survey, and only another 5.7% stated that their current union was not their first union.

A variable indicating the birth cohort was included in each model. As in the Kaplan-Meier estimates above, we used five-year birth cohorts starting from 1965–69. For each cohort, the relative hazard ratios compared to those of the reference birth cohort of 1965–69 are considered. A number of socio-economic and cultural parameters are also added to the models. Thus, in all of the models that have covariates in addition to the cohort variable, parameters of urban/rural residence and educational level are included. The education parameter was dichotomic, and distinguished between higher educational levels (studying at a university or an institute, with or without having completed a degree) and lower educational levels. To measure the impact of ethnicity, the parameter of the mother tongue of the household head was included in the models. In the MICS2014 database, this is the only proxy for ethnicity. Recall that the mother tongue, rather than the self-reported ethnic identity, was shown to be significant for marriage behaviour in existing studies of post-Soviet Kyrgyzstan (see Section 3).

The MICS2014 survey offered a rather limited set of parameters that can be treated as indicators of gender asymmetries. We used the dichotomic parameter showing whether a woman considered a husband beating his wife acceptable (we assigned a positive meaning to this parameter when the respondent said that wife beating was acceptable under at least one condition in a list of conditions proposed in the survey questionnaire). We assumed that if a woman accepted domestic violence, this acceptance was probably imposed on her by the norms and behavioural

standards she has encountered either among her relatives or in her husband's family. In the models for the transition to the first child, we additionally included the age gap between the woman and her partner. A larger age gap between a woman and her partner was often associated with more strict gender asymmetries in a family (Casterline et al. 1986). As a socio-economic variable, we also used the level of wealth (a quantile wealth index; hazard ratios for women of different quintiles relative to the lowest quintile are considered). Finally, the frequency of internet access was included as a parameter in the models. Generally speaking, internet access was expanding in Kyrgyzstan in the 2000s and the 2010s, with the overall penetration rate reaching 78.6% in 2018, according to the State Communication Agency. At the same time, the extent to which women in Kyrgyzstan have access to the internet is likely to reflect certain cultural differences. It may, for example, be noted that women of different ethnic groups have different levels of internet access (see Table 1), with Kyrgyz women having greater access than Uzbeks, and both ethnicities having less access than Russians.[5]

The education, urban/rural residence, employment, and wealth index parameters were time-fixed in our models because the MICS data did not allow us to have these parameters varying across a woman's life course. Assigning the educational level a woman had reached by the time of the survey to all months of her life course that were included in the analysis seemed justifiable because women normally start higher (tertiary) education at ages 18–19 in Kyrgyzstan, which means that only the very early stages of a woman's reproductive period would be unaffected by the decision to enrol in higher education (moreover, it was highly probable that a woman would spend the years between turning age 15 and entering university preparing for admission exams, which would also influence her marriage and fertility behaviour at that time). Treating the level of wealth as a time-fixed variable was justified by its rather undetailed, quintile-based scale; and given the relatively low levels of wealth mobility in Kyrgyzstan, it was improbable that a woman would radically change her position on the scale during her life course (movements between neighbouring quintiles were not expected to produce serious distortions).

Table 1 contains descriptive results on the parameters included in our analysis for women born between 1965 and 1998, for the whole sample, and for the three major ethnicities.

Table 2 shows Cox regressions for entering the first union, and Table 3 shows Cox regressions for the transition from the first union to having one child for the whole sample. In both tables, a regression is included with the birth cohort as the only variable, and then a series of regressions are included to which the other covariates

[5] Note that these differences between ethnicities cannot be accounted for by the proportions of urban women among them (based on the assumption that internet access is better in urban areas), because the proportion of the population living in urban areas is higher among the Uzbeks than among Kyrgyz, according to Kyrgyzstan National Statistics Office (Ezhegodnik 2017), whereas internet access is greater among the latter than among the former.

Table 1:
Distribution of some parameters in the MICS2014 (total and by ethnic groups)

	All	Kyrgyz	Uzbeks	Russians
Urban,%	38.5	35.2	49.1	62.2
Higher education,%	25.4	28.7	8.1	38.1
Accepting domestic violence,%	38.0	37.7	46.6	12.9
Age gap with husband, mean	4.57	4.53	4.85	4.08
Wealth quintiles,%				
Poorest	21.8	24.2	18.6	1.4
Second	19.0	20.9	16.3	1.9
Middle	19.4	17.8	31.5	7.4
Fourth	20.3	17.3	29.5	30.1
Richest	19.5	19.8	4.1	59.2
Having a job (among those born in 1989–1998),%	10.0	9.4	6.1	28.7
Access to internet (among those born in 1989–1998),%				
No	1.5	1.3	3.2	1.1
Less than once a week	13.0	11.7	28.5	2.2
At least once a week	23.5	23.5	31.5	10.9
Almost every day	62.0	63.5	36.7	85.9
N	6684	5029	1070	365

are successively added. The following asymmetries between women of different birth years can be seen. First, women of the 1980–84 birth years had a significantly lower propensity for both entering a first union and giving birth to a first child than women of other birth years. The findings for entering the first union hold for both the regression with the cohort as the only variable and the models with the addition of covariates. For the first birth, this effect was observed only in the models to which covariates were added. Second, the cohorts born in the 1990s were shown to have significantly higher risks of both events. This was especially clear for the transition to motherhood, for which both the 1990–94 and 1995–98 birth cohorts were found to have significantly higher risks than women of older generations in the regressions both with and without the covariates added (note, however, that for the 1995–98 birth cohorts, the results on the transition to motherhood could be spurious, as the subgroup of that cohort who were already in partnership by the time of the survey – i.e., before age 20 – was highly selective). For the transition to the first union, the risks were shown to be significantly higher for the 1990–94 birth cohort only, and only in the regressions with the covariates added, and the risk ratios with the oldest generation were found to be smaller. Nevertheless, the analysis confirmed that none

Table 2:
Risks of transitioning to a first union by age (Cox regression, starting at age 15)

	(1)	(2)	(3)	(4)	(5)
Birth cohort					
1965–69	1	1	1	1	1
1970–74	0.985	1.006	1.020	1.019	1.017
1975–79	1.082	1.099*	1.097*	1.086	1.082
1980–84	0.844**	0.885**	0.876***	0.871***	0.868***
1985–89	0.912*	0.994	0.983	0.978	0.974
1990–94	1.073	1.182**	1.177***	1.186***	1.183***
1995–98	0.963	0.973	0.964	0.984	0.983
Area					
Urban		1	1	1	1
Rural		1.235***	1.237***	1.233***	1.177***
Education					
No higher education		1	1	1	1
Higher education		0.558***	0.580***	0.590***	0.600***
Ethnicity					
Kyrgyz			1	1	1
Russian			0.792***	0.824***	0.844***
Uzbek			1.213***	1.201***	1.178***
Accepts domestic violence					
No				1	1
Yes				1.176***	1.164***
Wealth index					
Poorest					1
Second					1.014
Middle					0.985
Fourth					1.031
Richest					0.881**
Chi-square significance	$p < 000.1$	$p < 000.1$	$p < 000.1$	$p < 000.1$	$p < 000.1$
−2Log Likelihood	80047.708	77377.740	77336.277	77305.410	77295.171
N	6304	6304	6304	6304	6304

Table 3:
Risks of transitioning to a first birth in a union (Cox regression, by the time since the first union)

	(1)	(2)	(3)	(4)	(5)	(6)
Birth cohort						
1965–69	1	1	1	1	1	1
1970–74	1.055	0.995	1.001	0.997	0.985	0.985
1975–79	1.139**	1.075	1.079	1.071	1.057	1.055
1980–84	0.934	0.901**	0.894**	0.891**	0.874**	0.878**
1985–89	1.057	1.097*	1.087	1.083	1.062	1.064
1990–94	1.806***	2.053***	2.038***	2.035***	2.002***	2.002***
1995–98	6.239***	7.344***	7.236***	7.250***	6.998***	6.998***
Area						
Urban		1	1	1	1	1
Rural		1.100***	1.116***	1.117***	1.125***	1.122***
Education						
No higher education		1	1	1	1	1
Higher education		0.606***	0.626***	0.632***	0.639***	0.640***
Ethnicity						
Kyrgyz			1	1	1	1
Russian			0.950	0.972	0.967	0.963
Uzbek			1.183***	1.175***	1.174***	1.156***
Accepts domestic violence						
No				1	1	1
yes				1.097***	1.093***	1.094***
Age gap with husband					1.009***	1.009***
Wealth index						
Poorest						1
Second						0.998
Middle						1.009
Fourth						1.101*
Richest						0.958
Chi-square significance	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$	$p < 0.001$
−2Log Likelihood	67394.563***	67041.169	67023.350	67014.196	66990.649	66982.233
N	4555	4555	4555	4555	4555	4555

of the models showed a trend towards postponement of the first union or of the first birth in the younger cohorts, and that most of the models indicated that the direction of change went in the opposite direction.

Both Tables 2 and 3 show that adding the socio-economic and cultural variables made the analysis more accurate (this was obvious due to the higher −2Log Likelihood statistics in the regressions to which the variables were added). These

findings justified considering models to which the variables were added, although the Chi—square indicator was significant even for the regressions that only included the cohort variable.

Most of the additional covariates had a significant effect on the propensity for at least one of the events to occur. Ethnic differences were also detected by the analysis, as both of the risks under study were found to be significantly higher among Uzbeks than among Kyrgyz. Moreover, Russians were found to have significantly lower risks of entering a first union than Kyrgyz and Uzbeks. However, for the transition to motherhood, the differences between Russians and Kyrgyz were shown to be insignificant. Both the first union and the first birth risks were found to be lower among women with higher education and among urban women. Among the indicators of family relations, acceptance of domestic violence was shown to be significantly related to higher risks of both entering a first union and having a first birth. A larger age gap between a woman and her husband was also found to increase the risk of transitioning to a first birth, although the size of the risk ratio was very small. Finally, the propensity for entering a first union was revealed to be significantly lower among women of the richest wealth quintile. The significance of the impact of wealth on the transition to the first birth was, however, found to be low.

We also ran separate models for women who were born between 1989 and 1998. We did this because the MICS data contained some additional parameters for those women which were of interest to us given our hypotheses: namely, having a job at the time of the survey and the frequency of internet use. The latter parameter could be important in light of our hypothesis that more strict gender and generational relations in a family were linked to the earlier timing of demographic events. We assumed that if a woman was able to use the internet frequently, this was an indication that her information sources and her ability to communicate were not being tightly controlled by family members (cf. Guilamo-Ramos et al. 2015).

Models for the transition to the first birth showed almost no significant effects for such women, probably because the numbers of women who were in a partnership among these cohorts were low, and are not shown here. Models for the transition to the first union are shown in Table 4. The differences between the cohorts were found to be insignificant, which is not surprising given that the period of births of women included in these models was smaller than those considered above. However, the models in Table 4 showed that the differences between women living in urban and rural areas and between women in different education groups did not become weaker in the younger cohorts. The contrast between accepting and not accepting domestic violence became even sharper, and the ethnic differences reported in Table 2 persisted. Women who were using the internet daily had significantly lower risks of entering a first union, and women who had a job at the time of the survey had risks of entering a first union that were almost three times lower than they were for women who did not have a job.

Table 4:
Risks of transitioning to a first union, women born in 1989–98 (Cox regression)

	(1)	(2)	(3)	(4)	(5)
Birth cohort					
1985–89	1	1	1	1	1
1990–94	0.917	0.909	0.880	1.062	0.976
1995–98	0.746	0.726	0.634	0.909	0.778
Area					
Urban	1	1	1	1	1
Rural	1.632***	1.600***	1.439***	1.464***	1.282***
Education					
No higher education	1	1	1	1	1
Higher education	0.466***	0.486***	0.467***	0.591***	1.126
Ethnicity					
Kyrgyz		1	1	1	1
Russian		0.581***	0.675*	0.671*	0.792
Uzbek		1.583***	1.626***	1.321***	1.084
Accepts domestic violence					
No					1
Yes					1.395***
Currently has a job					
No			1		1
Yes			0.351***		0.393***
Access to internet					
No				1	1
Less than once a week				1.259	1.366
At least once a week				1.198	1.460
Almost every day				0.541**	0.736
Chi-square	117.017***	139.227***	200.351***	223.915***	323.334***
−2Log Likelihood	6384.136	6363.387	6293.260	6291.976	6200.985
N	1482	1482	1482	1482	1482

6 Discussion

Our analysis has confirmed that the trend towards delaying motherhood did not start in Kyrgyzstan among women born in the 1960s to the early 1990s in the period up to 2014. The higher risks of entering a first union, and especially of having a first birth in a union, observed among the youngest birth cohorts seem

to point to a "rejuvenation" in the timing of the two events, and thus suggest a new tendency of "advancing" motherhood among younger women. Note that similar Cox regression analysis undertaken for some other post-Soviet countries that produced firm evidence of fertility postponement showed a gradual lowering of the risks of both events among the cohorts born in the 1980s and the 1990s (see, e.g., Mitrofanova (2017) for Russia). In Kyrgyzstan, a significant lowering of these risks compared to those among the older birth cohorts was detected for the 1980-84 birth cohort only. For the women of that particular cohort, this finding is expected, because they entered their reproductive period in the second half of the 1990s or in the early 2000s, when the economic and political situation in the country was still very uncertain. However, this postponement trend has not touched later cohorts in Kyrgyzstan.

The analysis has also shown that a number of social-economic parameters had significant effects on the likelihood of transitioning to a first marriage and a first birth in the cohorts under study. Our finding that higher education was associated with a lower likelihood of both entering a first union and having a first birth confirmed our Hypothesis 1, and is in agreement with similar results for other developing countries (see Section 2). We also found that women's employment had a similar effect, although we could analyse its influence among the younger cohorts only. Our findings on the effects of women's education and labour market position support our first hypothesis. Our observation that the wealthiest women had a lower risk of entering a first union may be partly related to the higher education levels in this social group. However, since education retained its significance when considered together with the wealth index (Model 5 of Table 2), it is possible that some other characteristics of the richest quintile of women supported the postponement of the first union among this social group. Interestingly, the wealth index was found to be insignificant for the likelihood of transitioning to motherhood, which suggests that the fertility behaviour of married women in the "upper class" of Kyrgyzstan society did not differ radically from that of their counterparts in other strata.

Although our data allowed us to include only a few indicators on generational or gender relations, our results showed that these indicators influenced union formation and first birth timing in the ways Hypothesis 2 suggested. Our finding that the risks of both events were higher among women who accepted domestic violence showed that earlier transitions were characteristic of women who indicated that they see the position of the wife in the family as strongly subordinate. The differences in the timing of union and motherhood between women with different views on gender norms and gender relations became even stronger among the younger generations. This sharper differentiation of family behaviour by gender norms was, however, shown to be accompanied by a decreasing share of women accepting domestic violence among the younger cohorts. In the MICS2014 sample, the proportion of women who said they consider it acceptable for a husband to beat his wife under some conditions gradually declined from the 1975–79 birth cohort (42.4%) to the 1995–98 birth cohort (23.5%). As accepting domestic violence became a "minority"

view, it emerged as an important factor in the early transition to marriage and motherhood.

Whereas the attitude towards domestic violence was an ideational factor, the age gap between partners appears to have signalled the actual gender asymmetries in a woman's family. The significant relationship we found between a larger age gap and a higher risk of having a first child confirmed our hypothesis that greater gender asymmetries supported earlier birth timing, although the risk ratios were shown to have changed only slightly with each annual increase in the gap (Models 5 and 6 of Table 3). The age gap between the partners and its effects were not found to have changed much between the cohorts included in our study, with the average age gap being at a rather high level of 4.5 years, according to the MICS2014 data. Thus, our analysis suggested that there was a family organisation parameter that was stable across cohorts, and that at least moderately supported earlier family formation.

The lower propensity for entering the first union found among women of the younger cohorts who were using the internet daily can be interpreted in light of our Hypothesis 2 as well, provided we assume that more frequent internet use indicates that a woman's family members were exercising less control over her. However, the differences in the frequency of internet use could also reflect different levels of network connection quality in different parts of the country.

Our hypothesis concerning ethnicity (Hypothesis 3) was generally confirmed, as the parameter of native language of household head, which was used as the proxy for ethnicity, was found to be significant for both the first union and the first birth risks. For both events, the risks were highest for Uzbeks and lowest for Russians. However, the differences between the different ethnicities were shown to be stronger for the first union than for the first birth. In addition, the differences in the likelihood of transitioning to a first birth were found to be significant between Uzbek and Kyrgyz women, but not between Russian and Kyrgyz women. Although we were unable to identify the factors that underlie these ethnic differences based on the available data, we were able to relate the earlier timing of unions and births among Uzbek and Kyrgyz women to the lower social status of women in these ethnic groups. Descriptive data from Table 1 support this view, as compared to both Kyrgyz and Uzbek women, Russian women had higher levels of educational attainment, employment, and daily internet access, and were more likely to reject domestic violence. Kyrgyz women, in turn, had much higher levels of education and daily internet access than Uzbek women. The results also showed that the share of women accepting domestic violence was highest among Uzbeks, at almost 50%. However, it is important to note that ethnicity was significant in the models in which these parameters were independently included. Therefore, if the inter-ethnic differences really can be explained by different degrees of family "conservatism", some other elements of that "conservatism" probably come into play that are not observable in our data.

Overall, our research on Kyrgyzstan provides insights into a society that experienced a shift towards early entry into the first union and motherhood among younger generations – which seems to contrast with the delayed family transitions observed

in highly developed countries and in the majority of developing countries. Our study showed that the changes in the timing of the first union and of the first birth within a union did not need to occur completely in parallel across generations. We also found that the factors driving the earlier timing of these two events could differ. These results suggest that when studying developing countries, it is important to model the transitions to the first union and the first birth separately. Especially in countries like Kyrgyzstan, which has a negligible level of out-of-union fertility, this separate modelling allows analysts to decompose changes in first birth patterns into the effects of union formation and of the first birth within a union. We have demonstrated that the earlier timing of family events was correlated with women having a subordinate position in the family and lower levels of education and employment outside of the household. These findings suggest that fertility timing is dependent upon "traditionalism" in family relations; and, in turn, that future trends in union and birth timing will be influenced by family "(de)traditionalisation". This hypothesis needs to be investigated more thoroughly across countries, which could be complicated by the differences in the measures of generational and gender relations that are available for different developing countries. Finally, our analysis has shown the significance of ethnicity for the timing of family transitions, which cannot be explained away by inter-ethnic differences in a woman's position in her family. This finding calls for broader research on the role of ethnicity in the timing of union formation and motherhood across developing countries.

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Appendix

Table A.1:
Statistic tests showing the significance of differences in the cumulative probability of remaining childless between neighbouring birth cohorts in Kyrgyzstan according to the MICS 2014 and the DHS2012

	MICS2014			DHS2012		
	Log Rank	**Breslow**	**Tarone-Ware**	**Log Rank**	**Breslow**	**Tarone-Ware**
1970–74 to 1965–69	0.640	1.689	1.083	4.719**	18.544***	11.968***
1975–79 to 1970–74	1.401	2.648	2.005	1.257	2.023	1.366
1980–84 to 1975–79	6.419***	22.183***	15.808***	18.135***	25.371***	22.594***
1985–89 to 1980–84	4.187**	0.700	2.106	0.689	5.300**	2.768*
1990–94 to 1985–89	14.272***	22.896***	19.673***	9.379***	12.154***	11.102***

Source: Computed on the MICS and the DHS database.

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Marital fertility decline and child mortality in the Sardinian longevity Blue Zone

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Abstract

Several authors have studied the late fertility transition in Sardinia, which did not start until the 1950s. This contribution aims to investigate the association between the decline in marital fertility and the fall in infant and child mortality. We use individual data to undertake classical family reconstruction starting from the mid-19th century for the population of two Sardinian villages, Villagrande Strisailli and Seulo, which we have previously studied for their remarkable longevity. Our results indicate that in this population, there were very few signs of fertility decline prior to 1920, and fertility decreased only gradually before 1950, but that the decline in fertility accelerated thereafter. We also found that infant and child mortality decreased slightly between the two world wars, and did not decline substantially until after the Second World War. The question arises as to whether these two transitions were associated, and, if they were, which one preceded the other. Our results suggest that there was some degree of synchronisation, with more pronounced changes beginning in the 1950s. We found that this association cannot simply be explained by a causal relationship based on altered demographic behaviour. Substantial socio-economic changes that began between the two world wars and developed fully in the 1950s might have caused both fertility and mortality declines within a traditional society that was undergoing a transition to adapt to the modern world.

Keywords: marital fertility; infant mortality; child mortality; demographic transition; family reconstruction; Sardinia; longevity blue zone

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1 Introduction

Although the historical decline in fertility has been extensively studied since the 1970s, particularly in Europe after the results of the European Fertility Project became available, it is still an attractive research topic, as more detailed data are emerging, and existing theories can increasingly be tested among specific populations (Brown and Guinnane 2018; Fernihough and McGovern 2014; Reher et al. 2017; van Poppel et al. 2012). Our interest here is in the long-term fertility decline among a population who were somewhat isolated and followed a traditional lifestyle characterised by high levels of fertility up to the mid-20th century. In this contribution, we study two villages in Sardinia – Seulo and Villagrande Strisaili (hereafter referred to Villagrande) – whose inhabitants are remarkable for their exceptional longevity (Poulain et al. 2004, 2011). The availability of historical aggregated and individual genealogical data for these villages that have been collected since the first half of the 19th century enable us to study the long-term decline in fertility in this population over more than a century. The fertility transition in the mountainous areas of Sardinia where these villages are situated occurred later than it did among other populations in Italy and in Europe in general. Under the auspices of the European Fertility Project developed in Princeton, Livi-Bacci (1977) found that for all of Italy, the Coale's Index of marital fertility I_g declined the latest in the mountainous province of Nuoro, where families with six or more children were still common until the 1950s. Furthermore, the historical trends in infant and child mortality in this region differed from those observed in other parts of Italy. The decrease in mortality began later in Sardinia (Gatti 2002), although lower levels had already been observed at the beginning of the previous century. Our interest here lies in investigating the questions of whether and, if so, how these two relatively late and synchronous fertility and mortality declines were associated, and whether one preceded the other. Our study might provide evidence of a causality in this association.

2 Background and research questions

The relationship between mortality and fertility has been a topic of interest since the beginnings of population research. The main focus of this research has been on how infant and child mortality has affected the reproductive behaviour of mothers (Knodel 1988). It was argued that among pre-transitional populations, the relationship between fertility and mortality resulted in low levels of natural increase in the population. Since the demographic transition theory was formulated, the decline in fertility has been attributed to four different factors: (i) the decline in mortality, particularly child mortality, which reduces uncertainty about the survival of children; (ii) fewer interruptions of breastfeeding due to the early deaths of children, which tends to increase the intervals between births, as suggested by Knodel (1988); (iii) the desire of couples to have a given number of surviving

children – the so-called "replacement factor" (Schultz 1969); and (iv) sequential decisions related to the birth of the next child depending on the outcome of each pregnancy (O'Hara 1972). In general, the theoretical perspective assumes that there is a positive association between marital fertility and infant mortality levels; i.e., that higher infant mortality is associated with higher fertility, and *vice versa*. This association has been studied at both the aggregate (community) and the family levels.

Most studies on this topic have found that at the community level, the decrease in infant and child mortality and the decline in marital fertility are indeed linked, or are, at least, associated. Nevertheless, there is no consensus about the causality of this association – i.e., about whether the decrease in infant and child mortality preceded or followed the decline in marital fertility. Schultz (1969) assumed that an established pattern of childhood mortality at the community level would influence couples' lifetime reproductive behaviour, leading them to seek to compensate for the expected death of their offspring. The duration of breastfeeding might help to explain why higher fertility could result from higher mortality, since the death of an infant would eliminate the contraceptive effect of breastfeeding. In addition to the reduction in the period of post-partum infertility, the possible deterrent to intercourse posed by the presence of an infant would be removed. By contrast, Knodel (1988) found that a decline in fertility usually preceded a decrease in infant mortality. Similarly, Reves (1985) hypothesised that it was the decline in fertility that caused the decrease in infant mortality resulting from infections. This argument is important, because it is inconsistent with the notion that the decline in infant mortality initiated the decline in fertility. From this perspective, fertility change was not driven by the decline in infant mortality, but it may have been a component of the broader infant mortality transition. The results of recent studies do not reflect a systematic agreement with any of these theories. In light of more recent results, some of which are controversial, it is not clear in what order these changes appeared, or whether they were interrelated (Brown and Guinnane 2018; Fernihough and McGovern 2014). The processes that have occurred and are still occurring in different geographic settings and among various historical and contemporary populations suggest that there has been more diversity in the patterns of change than the theory of the fertility transition would predict. Thus, the relationship between the decline in fertility and the decrease in infant mortality is disputed by scholars who have, for example, argued it may be more complex than earlier theories predicted, and could vary between societies (Hirschman 1994). Some authors have argued that broader concepts or a kind of community understanding of how many children are likely to survive to adulthood must be operating in addition to individual choice (Lesthaeghe 1980; Sánchez-Barricarte 2018). Knodel (1988) has observed that a combination of educational factors, social and religious norms, and the availability of contraceptive methods operated indirectly (and presumably unconsciously) to adjust the level of community fertility to the level of community mortality. The adaptation to new forms of behaviour involves processes of innovation and diffusion that are reliant on three preconditions

for behavioural change to occur: *readiness, willingness* and *ability* (Coale 1973 as cited in Lesthaeghe and Vanderhoeft 2001). Recent research has repeatedly shown that in addition to the decrease in childhood mortality, increases in levels of education and economic development played important roles in the historical decline in fertility (Sánchez-Barricarte 2017, 2018). While the economic context clearly contributed to the decrease in child mortality, economic growth was also consistent with a decline in fertility (Brown and Guinnane 2018). Cultural and social factors conditioned the reproductive behaviour of couples, but mortality could also be affected by (temporal) socio-economic and political conditions.

At the family level, low child mortality might have encouraged a mother to stop bearing children before she became biologically sterile, whereas the death of several children could have caused her to follow the traditional pattern of uncontrolled fertility. It is, however, also possible that the death of several children would have discouraged a couple from continuing to have children in order to avoid additional disappointment (Knodel 1988). Moreover, children who were born later in the sibling order had a higher mortality risk than those who were born earlier (Modin 2002), and the death of a higher parity child could indicate that the mother had a physical limitation that prevented her from continuing to bear children. It was thus assumed that the parents' decisions about whether to have another child were sequential, and depended on the outcomes of previous childbirths, rather than on an intention to have a certain number of surviving children (Williams 1977). While the discussion about the association between fertility decisions and child deaths has not reached a consensus, an association has been observed between the loss of a child and the birth interval (Schultz 1969; Plana-Ripoll et al. 2018). If a decline in fertility could be interpreted as a decline in the total number of surviving children a woman or a couple wanted to have, a decrease in infant and child mortality should have lowered the fertility level. It appears, however, that the effect of low mortality on couples' decisions to reduce the number of subsequent pregnancies does not adequately explain why couples gradually reduced the number of children they had to replacement level during the fertility transition. Moreover, for the population as a whole, having smaller families could have resulted in the same or even higher levels of fertility, as happened during the post-war baby boom (Preston 1976).

The association between fertility outcomes and child mortality has been mostly studied for the early period of the European demographic transition. Given that both fertility and infant and child mortality decreased relatively late in Sardinia – gradually after the First World War, and more substantially after the Second World War – this study aims to provide new insights into this topic by examining both aggregated and individual data obtained through family reconstruction.

We seek to answer the following research questions regarding a possible association between the decline in fertility and the decrease in infant and child mortality:

- At an aggregate level, were the declines in marital fertility and the falls in infant and child mortality synchronous? Is there any indication based on the aggregated data that one of these two trends preceded the other, which could indicate a causal effect?

- The next question is addressed using individual data to analyse mothers' fertility behaviour in relation to the survival of their children. We study whether the loss of a child due to stillbirth or death during the first year of life increased the probability of having another child. Such an effect might be seen as reflecting an intention to replace the lost child.
- When another child was born after the death of a sibling, we examine whether this birth affected the length of the next birth interval. If the interval was shorter than the other intervals, it could be seen as an implicit mechanism for replacing the lost child that would tend to increase the total number of children the mother has.
- From a different perspective, we will investigate whether maintaining the same level of the net reproduction rate, and, more specifically, the number of children surviving beyond age five, might explain the long-term historical equilibrium between mortality and fertility, as suggested by Cleland (2001).
- In addition, we aim to analyse whether the survival of children correlates with mothers having a higher number of children or shorter birth intervals.
- Moreover, with regard to the two villages under study, we will discuss the possibility that a common socio-economic and cultural context contributed simultaneously to the sharp decrease in fertility and the steep decline in infant and child mortality.

3 The population and data sources

Past research has revealed that the fertility transition occurred later in Sardinia than in other parts of Europe. At the beginning of the 20th century, high levels of marital fertility were reported on the island (Livi-Bacci 1977; Bernardi and Oppo 2007). As late as in the 1950s, the province of Nuoro in the mountainous region of Sardinia exhibited the highest levels of Coale's Index of marital fertility (Ig) among all of the Italian provinces observed during the fertility transition. It has also been reported that in some inland areas of the island, mostly in the province of Nuoro, the population has been characterised by exceptional longevity (Poulain et al. 2004) and late fertility (Astolfi et al. 2007, 2009) – and that there could be an interesting linkage between these two trends (Poulain et al. 2016).

Two villages, Seulo and Villagrande, were selected for this study on the basis of the authors' interest and the findings from earlier research conducted in these communities on the reasons for their exceptional longevity (Poulain et al. 2004). In addition to being known for their longevity, both villages are located in an area where fertility and mortality transitions have tended to occur much later than they have in most other Western populations (Livi-Bacci 1977; Bernardi and Oppo 2007; Poulain et al. 2016). Seulo and Villagrande are situated more than 700 meters above sea level on the southern slopes of Punta La Marmora, the highest mountain in Sardinia at an altitude of 1,834 meters.

In 2018, 3,186 inhabitants were living in Villagrande and 835 were living in Seulo (ISTAT-*Istituto Nazionale di Statistica*). The first general census of the population of a unified Italy in 1861 recorded 1,251 inhabitants in Villagrande and 714 inhabitants in Seulo (ISTAT). The population grew continuously from 1861 to the second half of the 20th century, reaching a maximum of 1,772 in Seulo in 1961 and of 4,029 in Villagrande in 1971.

Historically, the main economic activity in both villages was sheep farming on the surrounding slopes, and also on the coastal plain in winter and higher in the mountains in summer. These cycles of transhumance took men away from their village for most of the year (Salaris 2009). In general, the village constituted a self-sufficient economic system in which each family member contributed to the household. The men were mainly responsible for raising animals and providing the family with food and raw materials (Salzman 1998). The women were primarily responsible for keeping the house, planting and maintaining terraced gardens near the house or surrounding the village, gathering firewood and weaving. The children in the family worked alongside their parents. It was a matriarchal society characterised by a high level of endogamy: more than 80% of marriages occurred between people of the same village, often between distant relatives (Cannas 2007).

The regional economy expanded in the 1950s when better roads and communication opened both villages to the external world. Simultaneous improvements occurred in health services, the pension system, education and social security. Even though this region was among the poorest on the island until the 1960s, these economic improvements rapidly raised the welfare standards of the populations of both villages nearly to the average for Italy. One of the outcomes of these developments was that most women started having their births in maternity hospitals in neighbouring towns.

Ascertaining the drivers of a decline in fertility and its possible association with a decrease in infant and child mortality is often hindered by a lack of suitable data; e.g., individual longitudinal data covering a long period of time. While a number of studies have been undertaken to collect such data by using the family reconstruction technique, not all were able to cover sufficiently long periods of time (Sánchez-Barricarte 2018). The present analysis uses data collected by classical family reconstruction that span two centuries. More precisely, the database covers the whole population for a period from the beginning of the 19th century to 1 January 2018, including births that occurred in the earliest years and deaths or survival information from the latest years. The municipalities of the two villages supported the collection of the demographic genealogical data. The main data source we used was a system of civil records of demographic events that was first introduced in Italy in 1866. The records from this source were checked against parish records of marriages, burials and baptisms for the earliest years of civil registration (from 1866 to 1900). No significant differences were found between the records from these data sources. In addition, to ensure that we were including all births, we consulted the population register (*anagrafe*), which was initiated at the end of the 19th century; and the 1951 census enumeration and confirmation

lists. We also examined the family histories of women born between 1840 and 1989 in Villagrande and Seulo. The investigation involved 3,006 married women, 2,582 of whom had at least one child. Among this group, 47 women remarried and consequently appeared more than once in this analysis.

The following criteria were used to select the married couples for whom a completed fertility history was constructed:

- The woman or her husband were born in Villagrande or Seulo, and the woman's date of birth was well-documented and occurred between 1840 and 1989.
- Both spouses survived and lived in Villagrande or Seulo until the woman reached the age of 45, or they were younger and were still living in one of the villages on 1 January 2018.
- The couple did not emigrate during their reproductive period; therefore, all of their children were born in the two villages, and their dates of birth were identified.

In total, we were able to compile complete, well-documented fertility histories for 2,353 couples in which both spouses survived up to the wife's 45th birthday. These women gave birth to 10,250 children from 1858 to 2017. The level of completeness of the information on the demographic events of each individual was high, as the date of death or evidence of survival was found for all but 85 new-borns.

4 Results

4.1 Trends in marital fertility

Our first step was to consider the so-called natural fertility period. To do so, we selected 749 women born from 1840 to 1890 who had married before 1920. We computed the marital fertility rates for 583 women in couples in which both spouses survived until the wife reached age 45 and who had at least one child. A total of 3,030 children were born to these women. Women who remarried after the death of their first husband were excluded. In these birth cohorts, 38 children born as "illegitimate" were also excluded, even if they had been recognised by their father. The calculation of marital fertility rates takes into account 71 married women who did not give birth to a child in their marriage. Childlessness among married couples during the natural fertility period was determined to be 12.2%, which is higher than the 7.1% rate found in Alghero by Breschi et al. (2009b) and the 10% rate reported in Casalguidi by Manfredini et al. (2009). This relatively high level of childlessness might be explained by the presence of a significant number of women who married a widowed brother-in-law close to the end of their fertile lifespan in order to care for the children of their deceased sister. Marital fertility rates in Villagrande and Seulo during the period of the natural fertility regime are compared with similar data from Hutterites and in Alghero in Table 1.

Table 1:
Marital fertility rates for completed families under a natural fertility regime in Villagrande and Seulo, for Hutterites and in Alghero

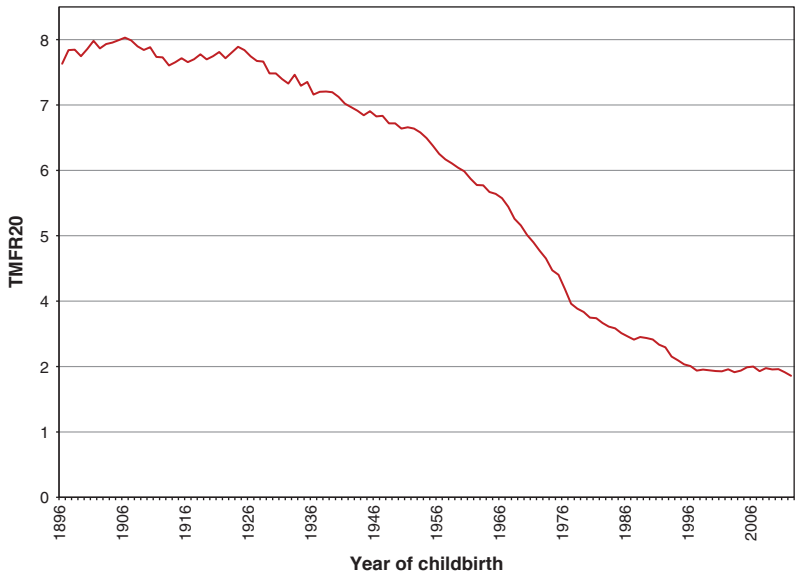
Age groups of mothers	Marital fertility in Seulo and Villagrande, women born 1840–1890*	Marital fertility for Hutterites, marriages 1921–1930 (Tietze 1957)	Ratio between Sardinian and Hutterite fertility rates (%)	Marital fertility in Alghero, marriages 1866–1885 (Breschi et al. 2009b)
Number of women	583	204		434
20–24	0.450	0.550	81.7	0.383
25–29	0.400	0.502	79.8	0.362
30–34	0.357	0.447	80.0	0.325
35–39	0.298	0.406	73.5	0.253
40–44	0.178	0.222	80.0	0.134
45–49	0.038	0.061	61.9	0.015
TMFR20	**8.61**	**10.94**	**78.7**	**7.36**
TMFR25	**6.36**	**8.19**	**77.7**	**5.44**

Note: *Corresponds to marriages occurring between 1865 and 1920.

The level of marital fertility found in Villagrande and Seulo was close to the highest figures computed by researchers who used the same family reconstruction method for other 19th-century villages in Italy. These Italian results range between 6.6 and 8.6 for the TMFR20 (total marital fertility rate starting at age 20) and 4.6 and 6.2 for the TMFR25 (total marital fertility rate starting at age 25) (Livi-Bacci 1977; Breschi et al. 2009a). Both rates were lower in Alghero (TMFR20 of 7.36 and TMFR25 of 5.44) (Breschi et al. 2009b).

As Table 1 shows, the ratio between the marital fertility rates for the same age groups of mothers in Seulo and Villagrande and in the Hutterite population does not vary greatly. The rates in Seulo and Villagrande are about one-fifth lower, which could be explained by the longer birth intervals in Seulo and Villagrande than in the Hutterite population (an average of 34.1 months, compared to 25.4 months among the Hutterites); and by the traditionally lengthy breastfeeding period in Sardinia, which was already mentioned by Coletti in 1908. Accordingly, for a comparable reproductive period, the expected number of children among mothers in the two analysed villages was systematically around one-fourth lower than it was among the Hutterites. Based on this result and the availability of data on marital fertility for each year of age of the mothers, we were able to determine the level of fertility under a natural fertility regime, and to assess the long-term trend in marital fertility for the two villages during the 20th-century fertility transition.

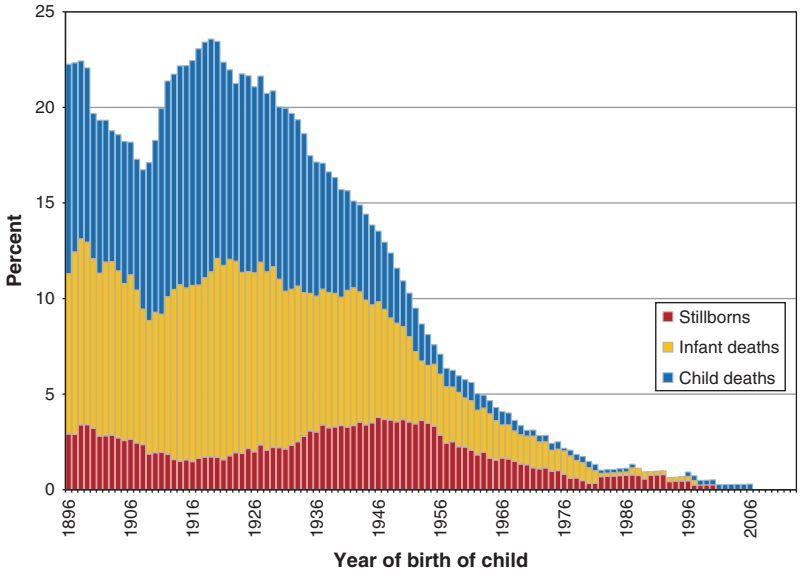
Figure 1:
Marital fertility in Seulo and Villagrande: TMFR20 by year of childbirth, 1891–2017 (11-year moving average)



The second step was to apply these age-specific marital fertility rates to all married women in Seulo and Villagrande for each year from 1891 to 2017. Consequently, we were able to estimate the number of children who would have been born if all of the married women in the two villages had conformed to the age-specific fertility rates characteristic of the natural fertility regime observed for mothers born up to 1890. The expected annual number of births was compared with the 9,811 births that occurred from 1891 to 2018, which allowed us to reconstruct the secular trend in marital fertility in the studied population (Figure 1). Children who were born as illegitimate (67) or were born to unmarried parents (82) were excluded from the observed number of births, as they had also been excluded from the computation of the corresponding expected numbers.

The trend shows that married women followed a natural fertility regime until the end of the First World War. A gradual decrease in fertility of about 20% subsequently occurred between the two world wars. A sharper fertility downturn began in the middle of the 1950s, and then accelerated and became more pronounced at the end of the 1960s. The overall fertility level fell even faster due to a strong increase in the proportion of women who did not marry (and stayed childless) during their fertile period. The share of never-married woman reached 15.4% during the natural fertility regime for the cohorts born between 1840 and 1890. It then rose sharply to 27.7% among women born in 1891–1929, and to 35.2% among those

Figure 2:
Share of stillborn, infant and child deaths in the total number of children by year of birth of the child, 1891–2017 (11-year moving average)

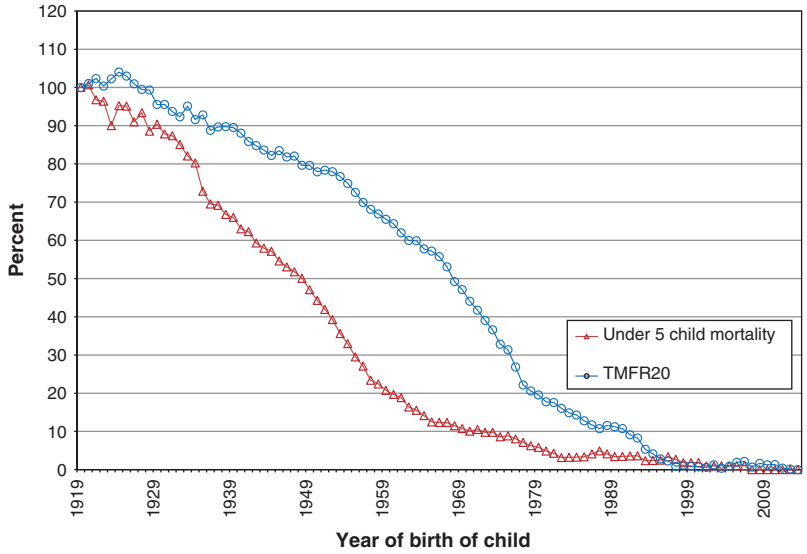


born in 1930–1959. Consequently, fertility dropped below the replacement level in the 1970s.

4.2 Trends in infant and child mortality

As early as in 1908, Coletti reported that in the 19th century, infant mortality was lower in Sardinia than it was other regions of Italy. Until 1890, it was difficult to estimate the "normal" level of child mortality under the age of five due to considerable fluctuations, and, presumably, due to the incomplete coverage of perinatal deaths. Although the two villages under study had particularly low levels of infant and child mortality, our careful investigation did not reveal any signs of significant under-reporting as of the last decade of the 19th century. Prior to the First World War, all types of mortality were decreasing at young ages; however, this trend was interrupted by the war (Figure 2). The post-war recovery was slow, and the low levels of child mortality recorded before the war were not reported again until the 1930s. In Villagrande and Seulo, the average level of infant mortality for the years 1901–1935 was 9.2%, compared with 13.6% for the same cohorts in the neighbouring village of Urzulei, and 15.2% for the years 1910–1920 in Alghero (Breschi et al. 2007). The corresponding levels of child

Figure 3:
Relative decrease in the TMFR20 and in the proportion of deaths of children under age five between 100% corresponding to the average of the years 1913–2013, and 0% for 2007–2017, by year of birth of the child (11-year moving average)



mortality were 10.6%, 14.2%, and 17.5%, respectively. After the Second World War, mortality at young ages decreased sharply in the two villages, as it did in all of Sardinia (Gatti 2002).

4.3 Aggregate association between the decline in marital fertility and the decrease in infant and child mortality

The aggregated figures indicate that the declines in infant and child mortality and the level of marital fertility were synchronous. However, in the comparison of the two relative decreases, the decline in mortality appears concave, whereas the decline in fertility follows a more convex curve (Figure 3).

4.4 Individual approach to the association between the decline in marital fertility and the decrease in infant and child mortality

What type of association between the fertility of the mother and the survival of her children occurs at the individual level? Could this association, if it exists, be

responsible for the apparent synchronisation between the decline in fertility and the decrease in infant and child mortality at the aggregate level?

To answer these questions, we first explore the association between the survival of the child and the probability of giving birth to another child. The probability of having another child after the loss of the previous one due to stillbirth or death in infancy is generally higher than when the new-born survives its first year. In order to investigate this association more deeply, we compared mothers born before 1891, between 1891 and 1930 and after 1930, who represented the pre-transitional, transitional and post-transitional cohorts, respectively. Additionally, we identified the mother's age at the delivery of the previous child (before or after age 35); and, for the mothers in the transitional cohort, whether the year of birth of the previous child was before or after 1950, a year considered pivotal to the fertility transition. In the completed families under the natural fertility regime, the probability of giving birth to another child after a previous child had died in infancy (before age one) was about the same as it was when the previous child was still alive at that age (Table 2). We found a similar situation for the mothers born between 1891 and 1930, except if the mother was younger than 35 years old, or if her previous child had been born after 1950. For these mothers, as well as for those born after 1930, the probability of having another child was significantly higher if the previous child had died. These findings indicate that couples tended to replace their lost child; among the post-transitional cohorts, this pattern was found to hold regardless of age.

For mothers who gave birth to another child, we investigated the association between the interval before the next birth and the survival of the previous child (Table 3). As expected, we found that regardless of the mother's age group, the birth interval was considerably reduced if the previous birth was a stillbirth or an infant who died before reaching age one. Given a positive association, at a constant level of fertility, the number of births per woman should be larger when infant mortality is higher.

The probability of giving birth to another child and the length of the birth interval both suggest that the proportion of stillbirths and the level of infant mortality were associated with maternal fertility. By contrast, the share of stillbirths and childhood deaths within families was more important when the size of the family was larger (Figure 4). Taken together, these findings suggest that the association between a mother's fertility and the early mortality of her children was bi-directional.

The correlations between the proportion of stillbirths, children who died before age one and those who died between ages one and five on the one side, and the number of children born to the mother and the mean birth interval on the other side, are shown in Table 4. A distinction is made between mothers born between 1840 and 1890 and between 1891 and 1930. For the cohorts of mothers born after 1930, these correlations are not significant due to the small number of stillbirths and child deaths. Except for the proportion of stillbirths, the correlations are positive with the number of children and negative with the average birth interval, and all are statistically significant with a p-value < 0.01.

Table 2:
Probability of giving birth to another child when the previous child had died or was still alive at age one by cohort and age group of the mother

Birth cohort of mother	Age of mother at birth of previous child	Year of birth of previous child	Number of mothers	Probability of having another child: if previous child alive at age one (%)	Probability of having another child: if after the previous child died before reaching age one (%)
Prior to 1891	Less than 35 years	All	82	96.1	96.3
Prior to 1891	35 years and older	All	501	62.8	63.2
1891–1930	Less than 35 years	Before 1950	80	95.5	96.3
1891–1930	35 years and older	Before 1950	66	89.1	91.4
1891–1930	Less than 35 years	1950 and later	245	66.3	74.4
1891–1930	35 years and older	1950 and later	321	52.2	52.3
After 1930	Less than 35 years	All	636	72.2	91.9
After 1930	35 years and older	All	422	29.9	63.6
All mothers	**All**	**All**	**2353**	76.5	84.3

Finally, we investigated the number of children who were alive at age five resulting from the combined effect of the mother's fertility and the mortality of her children. Figure 5 displays the average number of children who survived to age five by the year of birth of the mother's last child. This indicator, which combines the fertility of the mothers and the mortality of their children, fluctuates above the threshold of four children until the 1970s, and does not decrease sharply until after this point.

5 Discussion

Family reconstruction data has been used extensively to study the fertility transition and its relationship with child mortality. However, this research has not yet provided

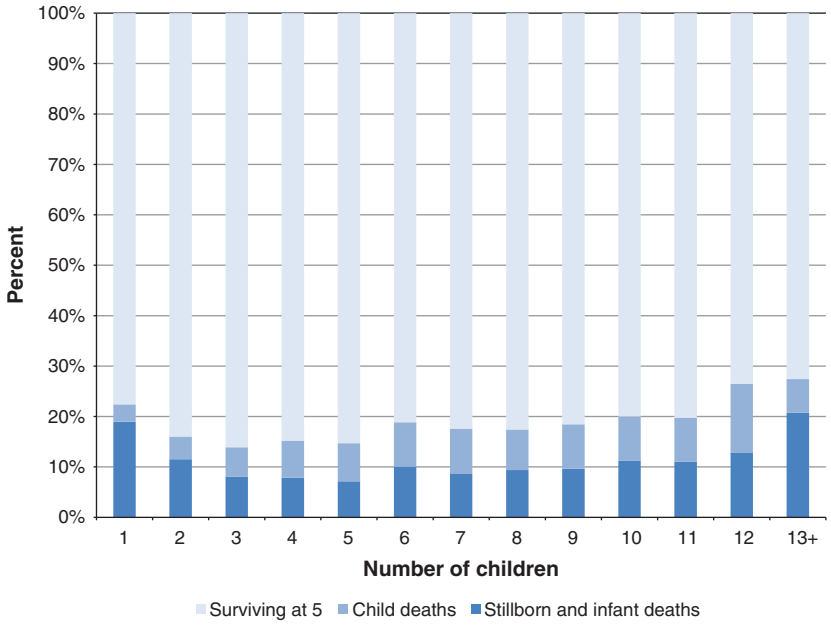
Table 3:
Mean birth interval when the previous child had died or was still alive at age one (including stillbirths, including or excluding last birth interval) by cohort and age group of the mother

			Mean birth interval in months			
			Excluding last interval		Including last interval	
Birth cohort of mother	Age of mother at birth of previous child	Year of birth of previous child	Previous child alive	Previous child died	Previous child alive	Previous child died
Prior to 1891	Less than 35 years	All	31.1	19.4	32.0	20.5
Prior to 1891	35 years and older	All	32.6	23.9	36.8	26.4
1891–1930	Less than 35 years	Before 1950	30.6	19.8	32.1	20.6
1891–1930	35 years and older	Before 1950	29.5	20.1	34.6	22.6
1891–1930	Less than 35 years	1950 and later	31.3	21.9	36.2	26.7
1891–1930	35 years and older	1950 and later	27.2	20.9	32.2	23.9
After 1930	Less than 35 years	All	29.8	20.7	41.1	21.0
After 1930	35 years and older	All	23.0	18.9	34.8	19.9
All	**All**	**All**	**30.6**	**20.2**	**35.1**	**22.2**

us with a clear understanding of the ways in which changes in mortality at young ages affected the reproductive decisions of couples during the fertility transition. In order to make progress in this field, the results of studies based on aggregated data should be complemented by findings based on individual behaviour obtained from genealogical data (Sánchez-Barricarte 2018). Does the decrease in infant and child mortality precede the decline in marital fertility, or vice versa? The association between these two processes still seems to be unclear, and should be studied in more detail with new data in order to identify possible underlying causal relationships.

The originality of our contribution stems from the in-depth view it provides of the association between the declines in fertility and mortality from both an individual and an aggregate perspective. In Villagrande and Seulo, as elsewhere in Sardinia, these fertility and mortality transitions occurred later than they did in the rest of

Figure 4:
Proportion of children living or deceased before reaching age five by the total number of children per mother with a complete fertility history during the natural fertility period (mothers born between 1840 and 1919)



Italy (Livi-Bacci 1977; Breschi 2012; Salvati et al. 2019). General fertility dropped below the replacement level in the 1970s as the result of a decrease in marital fertility and a rise in the proportion of women who did not marry up to the end of their reproductive span. Our findings show that a synchronous relationship existed between the decrease in childhood mortality and the decline in marital fertility. These trends originated between the two world wars, and then accelerated from the 1950s onwards. On the basis of this synchronism, we hypothesise that there may have been causal relationships between the decrease in childhood mortality and the decline in marital fertility.

However, despite their synchronism, these trends also exhibited differences. The decrease in mortality had a concave shape, whereas the decline in marital fertility was more convex. Based on aggregated data, we could interpret this finding as an indication that the decrease in childhood mortality was at least partly responsible for the simultaneous, albeit somewhat slower decline in marital fertility. However, the difference between the two trends could simply be due to the speed of changes induced by underlying factors. It is possible that in this traditional society, mortality responded relatively quickly to medical innovations and sanitary improvements,

Table 4:
Correlations between the proportion of stillbirths, children deceased before age one and between ages one and five per mother, the mother's number of children and the average birth interval

	Mothers born prior to 1890	Mothers born 1891–1930	Mothers born prior to 1890	Mothers born 1891–1930
	Number of children		Average birth interval	
Number of mothers	*583*	*712*	*583*	*712*
Proportion of stillbirths	0.158**	0.037	−0.044	−0.059
Proportion of infant deaths	0.114**	0.201**	−0.188**	−0.0118**
Proportion of child deaths	0.165**	0.198**	−0.182**	−0.098**
Proportion who died before age five including stillbirths	0.231**	0.255**	−0.312**	−0.016**

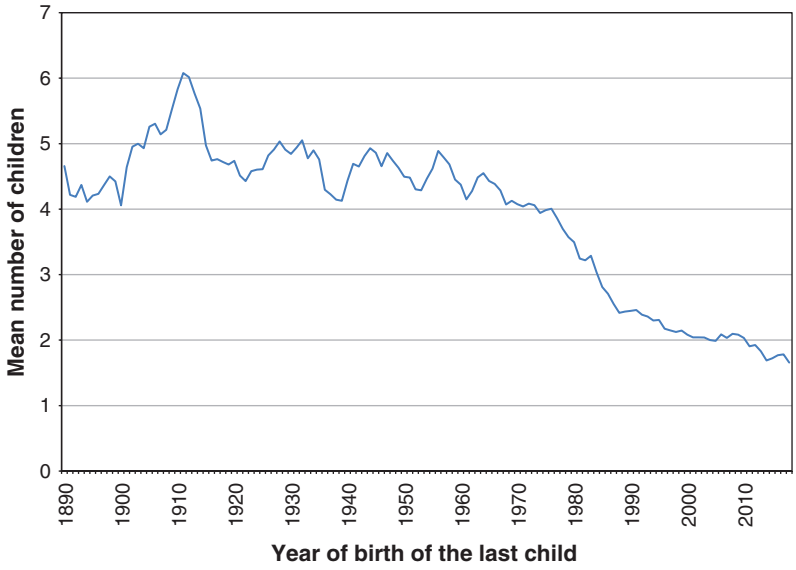
Note: **Statistically significant with $p < 0.01$.

while marital fertility was less responsive to underlying socio-economic and cultural changes. In Villagrande and Seulo, as elsewhere in Italy, these developments might have been influenced by the pro-natalist policy promoted by Mussolini in the 1930s.

A closer investigation of the mothers' individual fertility histories gave us a better opportunity to discern possible associations between the two processes. First, we examined the association between a child's survival and the probability of having another child. According to the replacement theory formulated by Schultz (1969), the decision to give birth to another child is deliberate. In the case of the two villages studied, this assumption appears to be confirmed by the fact that the name of a deceased child was often given to one of the following children of the same sex. However, we did not observe such conscious behaviour during the natural fertility regime; it first emerged during the transitional period, and did not become widespread until the post-transitional stage.

Empirically, the decrease in the number of stillbirths and infant deaths had a direct effect on fertility, as the birth intervals become much shorter after the loss of a child. Nevertheless, this effect was somewhat limited among our studied populations. Our finding that the average birth interval was 22 months after the death of a child, rather than 35 months if the child remained alive, implies that fertility might be no more than 15% lower, considering the average level of infant mortality. This factor, as

Figure 5:
Mean number of children alive at age five per mother with a complete fertility history by year of birth of the last child (five-year moving average)



opposed to the desire to replace a lost child, cannot be considered deliberate, but could be explained by physiological reasons, and its direct impact was slight.

Both of the factors we investigated suggest that the level of infant mortality, including the proportion of stillbirths, was positively associated with relatively higher fertility. Considering this association, the decline in stillbirths and infant mortality among our studied populations might have been at least partly responsible for the corresponding decrease in fertility.

From a different perspective, we observed that mothers with complete fertility histories who had more children or shorter birth intervals tended to have higher proportions of stillbirths and infant mortality. Our findings indicate that the number of children born to a given mother, as well as the corresponding mean length of her birth intervals (excluding those following an infant death), had an influence on the children's survival. A child had a better chance of surviving if the length of the birth interval since the previous birth was longer and the number of surviving siblings was smaller when he or she was born. Accordingly, a mother with lower fertility might have had a lower risk of losing her children. In this case, a decrease in fertility could have also resulted in a decrease in infant mortality. While the correlation we found between a mother's completed fertility and the survival of her children confirmed that there was an association between them, it does not shed light on the nature of this causal relationship.

In Villagrande and Seulo, the average number of children alive at age five tended to stay stable, at close to five per mother during the entire observation period until the 1970s, when analysed by the year of birth of the last child. Did the mothers reduce their fertility in order to keep the same number of children alive up to age five, given that infant and child mortality was decreasing? Our findings support the suggestion of Reher et al. (2017) that the number of surviving children, rather than a specific number of births, serves as an important predictor of the likelihood of having another child. During the transitional and post-transitional periods, this could indicate a conscious decision on the part of couples to limit the total number of children expected to survive. In order to maintain such stability after child survival improved, couples had to reduce their fertility. Nevertheless, even if all children survived until the age of five, the maximum expected impact on fertility would not have exceeded a 20% decrease.

It is also possible that losing a child had both physiological and psychological effects that reduced a couple's fertility (Knodel 1988). The psychological effects may operate at both the individual and the community level. Nevertheless, the effects at the community level should only emerge after a significant decline in infant and child mortality. Could a sudden and significant reduction in infant and child mortality, like the one we observed at the beginning of the 1950s, have unconsciously influenced couples to have no more children? The question remains unanswered.

In addition to the effects discussed above, the association between fertility and child survival cannot be explained without considering the socio-economic and cultural context. Socio-economic and cultural factors, such as an increase in well-being, more conscientious infant care, and better health at the community level, could be responsible for simultaneous decreases in fertility and child mortality. Recent research has repeatedly shown that in addition to the decrease in childhood mortality, the increases in levels of education and economic development played important roles in the historical decline in fertility (Sánchez-Barricarte 2017, 2018). While the economic context clearly contributed to the decline in child mortality, economic growth was also consistent with the fertility decline (Brown and Guinnane 2018). Cultural and social factors conditioned the reproductive behaviour of couples, but mortality may have also been affected by (temporal) socio-economic and political conditions. Livi (1961) and, more recently, Salvati et al. (2019) identified a period between the two world wars as a particularly relevant turning point in demographic dynamics. A similar period was noted during the 1970s. Both studies identified indicators characterising the pre-transitional, transitional and post-transitional phases of development.

In the case of the two villages in Sardinia, important changes occurred after the Second World War that significantly improved the well-being of the local population. The anti-malaria campaign initiated by the Americans in 1948 with the support of the Rockefeller Foundation had a direct impact on the sanitary conditions and health status of the local population (Tognotti 2009). At the same time, the external world became more accessible to the two villages due to better communications; the exchange of goods, services and ideas; and more exogamous marriages. According

to our anthropological surveys of couples born in the 1920s who were affected by these changes, several policies introduced in the 1950s stimulated improvements in the welfare of these traditionally rural populations, including changes in social security, pensions and access to health services. The introduction in 1962 of the compulsory education of children up to age 14 altered the role of children in their families. Boys became less available to help in the fields and to tend the animals, whereas girls provided less help with the housework. Increased emigration, higher levels of education, especially for girls, and better knowledge of contraceptive methods resulted in a sharp decrease in the number of children. From that period onwards, most couples limited their number of children to two or three. This shift occurred even before 1984, when the use of contraceptive pills became more common in both villages.

Our decision to focus on the two small villages was linked to our earlier research on the extreme longevity of their populations, which also revealed that these villages underwent the first demographic transition very late. While the fertility transition started between the two world wars, infant mortality did not decline sharply in these villages until after the Second World War. The small size of the population included in the analysis could be considered a limitation. However, the data are unusually complete, which enabled us to demonstrate the synchronism between the declines in fertility and mortality. Moreover, our long-term focus spanning from the late 19th century until the present was important, as the changes under study started later than they did in other regions of Italy. The conscious and unconscious actions taken by couples indicate that the decrease in mortality contributed to the decline in fertility. Nevertheless, the main impetus for the decline in fertility and the decrease in mortality was provided by the favourable socio-economic conditions that emerged in the 1950s, when the studied population gained greater access to the modern world. Many villages in other parts of Italy have been studied using comparable datasets for the same period. Accordingly, further comparative studies involving a variety of communities that differ in their economic, social and cultural characteristics are needed. Such studies could shed light on the specific economic and cultural factors that affect the fertility and mortality transitions, and their synchronism.

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Future orientation and fertility: cross-national evidence using Google search

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Abstract

Using digital traces to investigate demographic behaviours, I leverage in this paper aggregated web search data to develop a Future Orientation Index for 200 countries and territories across the world. This index is expressed as the ratio of Google search volumes for 'next year' (e.g., 2021) to search volumes for 'current year' (e.g., 2020), adjusted for country-level internet penetration rates. I show that countries with lower levels of future orientation also have higher levels of fertility. Fertility rates decrease quickly as future orientation levels increase; but at the highest levels of future orientation, this correlation flattens out. Theoretically, I reconstruct the role that varying degrees of future orientation might play in fertility decisions by incorporating advances in behavioural economics into a traditional quantity-quality framework à la Becker.

Keywords: future orientation; total fertility rate; hyperbolic discounting; quantity-quality trade-off; digital trace data; Google trends; digital demography

1 Introduction

"Demographic behaviour has a future orientation. People marry, cohabit, have children, divorce or migrate primarily because they have expectations or hopes about how the particular demographic change will affect their lives" (McDonald 1996, 385). While the idea that fertility choices involve an orientation towards the future is rarely disputed, it is seldom incorporated into models of childbearing decisions. Research on fertility as a future-oriented behaviour has typically focused on intentions in terms of ideals regarding optimal family size and the timing of

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childbearing (Bongaarts 1990). These intentions have been shown to correlate to the number of children at the individual level (Westoff et al. 1957; Schoen et al. 1999; see Morgan 2001 for a review), as well as to fertility rates at the broader society level (Goldstein et al. 2003; Hagewen and Morgan 2005). The literature has generally seen intentions as rooted in a variety of micro- and macro-level factors (Balbo et al. 2013), such as the prevailing gender equity level (Mills et al. 2008), socio-economic characteristics (Régnier-Loilier et al. 2011) and the contextual life course events of parents (Liefbroer 2009).

Emphasising instead the role that subjective factors may play, some studies have drawn on social psychology, and particularly on Ajzen's (1991) theory of planned behaviours, to argue that life course transitions can be better understood if greater reflexivity is assumed at the level of the decision-maker (Billari et al. 2009; Ajzen and Klobas 2013; Mencarini et al. 2015; see Philipov 2011 for a discussion). Drawing on these intuitions, I investigate in this paper the role that future orientation plays in fertility. Relying on advances in the field of behavioural economics, I conceptualise future orientation as a form of discounting. In particular, I discuss how varying degrees of intensity in the preference for rewards that happen sooner rather than later can affect childbearing in the heuristic context of a traditional quantity-quality framework à la Becker.

Analytically, I follow Billari's (2015) two-stage approach to explaining demographic change, which requires linking the production of evidence at the population level to micro-funded theories of individual behaviour. Indeed, according to Goldthorpe (2016), social research should seek to make population regularities both 'visible', i.e., by uncovering macro-level patterns that would be apparent in a general form to any equipped observer; and 'transparent', i.e., by determining the process by which those regularities that are established at the aggregate level are rooted in the actions and interactions of individual agents. Thus, after discussing why different degrees of preference for the present relative to the future may affect fertility from a theoretical, micro-level standpoint, I investigate the empirical relationship between a measure of future orientation and fertility rates at the population level.

Drawing from Preis et al. (2012), I leverage Google Trends volumes, and construct a Future Orientation Index as the ratio of the volume of Google searches for the 'next year' (a number) to the volume of Google searches for the 'current year' (also a number) for 200 countries and territories across the world in the reference years 2010 to 2016. I estimate that the digital trace data I employ to build this index capture the aggregate online search behaviour of about 2.3 billion individuals, or 31% of the world's population. However, because internet access is very unequal across the globe, I build on methods developed by Zagheni and Weber (2012, 2015) to correct this index in order to better account for biases in the generation of Google data. Based on this corrected measure, I document that countries that display lower levels of future orientation have higher levels of fertility. Fertility rates decline quickly as future orientation levels increase, but at higher levels of future orientation, this negative correlation flattens out. I conclude by reviewing the limitations of using Google Trends data for fertility research, and by proposing that further research

grounded at the micro level should be carried out in order reconstruct the role of future orientation in shaping demographic behaviour.

2 Theoretical background

2.1 Fertility as a future-oriented behaviour

The intuition that fertility intentions and behaviours entail an element of orientation towards the future can be traced back to seminal discussions of declining birth rates during the period when Europe and North America were undergoing the demographic transition. Frank Notestein famously stated that "the reduction of fertility requires a shift in social goals", brought about "in response to drastic changes in the social and economic setting" (Notestein 1945, 40). As Kirk (1996, 364) noted, Notestein drew from Carr-Saunders (1922), who focused on the role of customs and codes of conduct in regulating fertility in pre-transition societies in his book *The Population Problem*. By contrast, Caldwell (1976, 325) criticised this "Malthusian" emphasis on "attitudes, beliefs, traditions and irrationality", and instead stressed the role of rational choice in fertility behaviours. Building on Simon (1974), who argued that "fertility is everywhere subject to much rational control", Caldwell (1976, 355) observed that "fertility is high or low as a result of economic benefit to individuals, couples, or families in it being so".

According to Caldwell, fertility intentions primarily depend on the benefits of childbearing, which are, in turn, determined by the direction and the magnitude of intergenerational wealth flows, and their net balance, "from parents to children and from children to parents – over the period from when people become parents until they die" (Caldwell 1976, 344). Economic formulations of Caldwell's intuition model fertility as stemming from the maximisation of a dynastic utility function, based on the consumption of agents at one point in time, and on the consumption of the agents' descendants from that point in time into the future (Becker and Barro 1986). In such a framework, the decision of a couple to start having children is determined by the employment prospects of children, the monetary and psychological costs of avoiding childbearing (Becker 1960), and the interaction between the quantity and the quality of children (Becker and Lewis 1973). It follows that fertility declines if the relative price of having children increases, if income falls, or if there is a change in the shape of the couple's utility function for children versus for other goods (McDonald 2001).

Most recently, the evidence that that a number of countries are moving towards having low and lowest-low fertility levels has renewed the debate over whether economic rationality represents a satisfying explanatory principle when seeking to account for these developments (Caldwell and Schindlmayr 2003; Billari et al. 2004; Caldwell and Schindlmayr 2004; Caldwell 2004). Lutz et al. (2006) outlined a sociological driver of change by proposing that the formation of family size

ideals is supported through socialisation, and is passed on from one cohort to another. The role played by normative pressures has been also integrated into social psychological models, with extensive references to Ajzen's (1991) theory of planned behaviour. This theory posits that social norms interact with the economic benefits of childbearing perceived by prospective parents, and with the control that they believe they have over their desired behaviours (see, e.g., Philipov et al. 2006; Billari et al. 2009). Sobotka (2009, 390) has suggested that when faced with eroding social norms against childlessness and having only one child, young adults may "reduce their fertility intentions by becoming more realistic when assessing their fertility goals, taking into account competing lifestyle alternatives and their growing awareness of different obstacles that may unfold later in life".

A connected but relatively unexplored dimension of fertility intentions is how actual behavioural control might moderate the impact of intentions on behaviours. Actual behavioural control refers to the ability to perform a desired action, and, in the case of childbearing, has been variously defined as determined by internal and external constraints, such as wealth, income, employment, education, housing and health status (Billari et al. 2009, 447; see also Schoen et al. 1999, 791). According to Ajzen (2011), a further moderating factor in the intention-behaviour nexus is the ability of individuals to self-regulate. Departing from McEachan et al. (2011), who reviewed empirical evidence indicating that the association between intentions and behaviours weakens with the temporal distance between the measurement of an intention and the observation of a behaviour, Ajzen (2011, 1115) pointed out that "as time passes, an increasing number of intervening events can change people's behavioural, normative or control beliefs, modify attitudes, subjective norms or perceptions of control, thus generating revised intentions".

In this paper, I draw from advances in the field of behavioural economics to offer a simple analytical operationalisation of behavioural control. In particular, I focus on the role played by time discounting, or the preference for gratification sooner rather than later (Hariri et al. 2006). Ubiquitous in human decision-making, discounting may lead individuals to opt for rewards that happen sooner but are smaller, rather than for rewards that are larger but delayed. For example, a person might favour a $100 reward today over a $110 reward tomorrow.[1] Empirically, rates of discounting are found to decline over time. Following on the previous example, individuals might indeed prefer getting $100 today to receiving $110 tomorrow, but may be willing to wait 31 days to get $110 if the alternative is getting $100 30 days from now. In other words, willingness to wait increases as a function of the expected delay in getting the reward (Loewenstein and Thaler 1989).

Crucially, this discount structure, which is also called 'hyperbolic discounting', creates "a conflict between today's preferences, and the preferences that will be held in the future" (Laibson 1997, 445). According to Loewenstein and Thaler (1989,

[1] Experimental studies have found that discounting decreases with the size of the reward; i.e., the larger the reward is, the more willing individuals are to wait (Ainslie 1975).

186), "if the discount rate declines over time, people will always consume more in the present than called for by their previous plans".[2] Thus, time discounting can be seen as a realistic integration of the classical assumption of rationality of economic agents, or as way of incorporating the role of 'impatience' into analyses of human decision-making (Thaler 1981; 2018). While discounting has been investigated in a wide variety of settings, from saving to health behaviours (Strotz 1955; Laibson 1997; Barro 1999; Harris and Laibson 2001; Gruber and Kőszegi 2002; Diamond and Kőszegi 2003; Barlow et al. 2016), and particularly with regard to the implications for households in developing economies (Banerjee and Mullainathan 2010), little attention has been paid to the role discounting might play in childbearing decisions.

2.2 Hyperbolic discounting and the quantity-quality trade-off

To the best of my knowledge, only three previous studies have investigated the childbearing implications of discounting (Wrede 2011; Wigniolle 2013; Robson and Szentes 2014). Among these studies, Wrede (2011) and Wigniolle (2013) derived analytical solutions from a standard quantity-quality trade-off à la Becker, augmented by adding (quasi-)hyperbolic discounting to the utility function of a unitary household. Quasi-hyperbolic discounting penalises future rewards by a coefficient βk^t, composed by a constant factor, $\beta < 1$, which captures the presence of a negative preference for delays; and by an exponential factor, k^t, for any $t > 0$, which grows at a constant rate as the time from the reward increases. By setting $\beta k = 1$, this utility formulation is equivalent to that of a rational agent, while a fully hyperbolic formulation of the discount factor, such as $(\frac{1}{1+kt})^{\beta/\alpha}$, with β and α greater than zero, can also be used to capture decreasing rates of discounting.

To analyse the childbearing implications of discounting, I build on Wigniolle (2013, 72), and depart from a unitary household model with three periods. The number of children (quantity) is set in the first period, while the quality is set in the second period. Because parents may be assumed to want children, each child enters positively the utility of the household in period 1, but at an opportunity cost in terms of consumption due to the resources devoted to childrearing. In the second period, the household selects the level of 'quality', which also entails a consumption trade-off because investing in children is costly. In the third and final period, the quantity and the quality jointly enter the household's utility. This may reflect the altruism of parents who value both the number and the quality of their children, or the fact

[2] Referring to the choice between \$110 in 31 days and \$100 in 30 days, it has been pointed out that while hyperbolic discounters might choose to wait 31 days to get \$110, as the 30th day approaches, impatience sometimes kicks in, leading them to take the smaller \$100 reward.

that children may represent an investment good, as they can provide support to their ageing parents (Wrede 2011, 1056–1057).[3]

In this toy model, the representative household chooses the optimal number of children by maximising the instantaneous utility obtained across all three periods. In this simple set-up, quasi-hyperbolic discounting has straightforward implications: by penalising rewards that come later rather than sooner, it implies that the benefits of quantity, which enter utility in period 1, bear more weight in the household's maximisation problem than the benefits of quality, which enter utility in period 2. Thus, *ceteris paribus*, a 'hyperbolic discounter' household will invest relatively more in quantity than in quality. The main hypothesis is as follows: countries characterised by a greater bias towards the present (less future-oriented) will also have higher total fertility rates (TFR) than countries that are less present-biased (more future-oriented) (*Hypothesis 1*).

Given that in Becker's framework, quantity and quality are connected through the intertemporal budget constraint, setting a higher number of children in period 1 may lead the household to resort to a dynamic inconsistent solution in terms of quality – i.e., a lower-than-desired investment – in period 2, which is a feature of hyperbolic discounting. At the same time, because hyperbolic discounting implies that time preferences decrease over time, a higher level of future orientation – i.e., a greater willingness to wait – may lead the household to appreciate the prospect of receiving more benefits at a later point in time. This can be thought of as a shift in the relative weight of period 3. Thus, as the bias towards the present decreases (future orientation increases), the relative weight of future periods for the household's utility also increases, leading households to appreciate the benefits of old-age support (or of altruism) more. Because in this model the benefits of old-age support (altruism) are determined by both quality and quantity, a highly future-oriented household might have more children than a moderately future-oriented household. I therefore expect that at high levels of future orientation, the negative relationship between future orientation and fertility reverses (*Hypothesis 1a*).

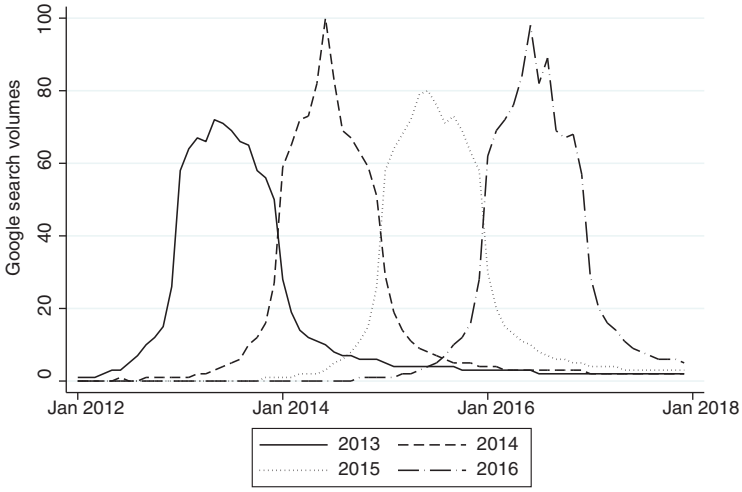
3 Data and methods

3.1 The Future Orientation Index

Through their digital behaviour, internet users leave traces that can be leveraged to measure their relative interest in the present, the past or the future. Preis et al. (2012) argued that the levels of relative interest in the future or in the past can be

[3] In period 3, the observation that both quantity and quality enter a household's utility function may be interpreted as indicating that a positive rate of investment in quality influences children's survival probability, their human capital, their future income, and other factors that are relevant for subsequent intergenerational transfers.

Figure 1:
Evolution of Google queries for a given 'number-year', 2012–2017, worldwide



measured by comparing the volume of searches for specific 'years'. Exploiting the fact that Arabic numerals are widely used across the world, they built a 'future orientation index' as the ratio of Google search volumes for future ($t + 1$) and past ($t - 1$) 'number-years' (e.g., interest in 2021 compared to interest in 2019, with reference $t = 2020$). In Figure 1, I show how interest in different 'number-years' varies across time by plotting monthly worldwide search volumes for the numbers '2013', '2014, '2015' and '2016', from 1 January 2012 to 31 December 2017.[4] I obtained these volumes through Google Trends, which draws from a subsample of all the queries submitted to *Google.com*. Search volumes are divided by the total number of searches, and then rescaled from zero to 100; thus, they represent a measure of the relative interest in specific keywords in a specific time period and geography.

Looking at Figure 1, it is possible to observe that queries for the 'number' capturing a given year start rising during the immediately preceding months, with a peak corresponding to December of the previous year. The relative interest in a given 'number-year' remains relatively stable throughout the following months, with peaks related to specific events. In 2014, for example, the male 2014 FIFA World Cup caused a surge in searches for '2014' during the summer months of that same year. However, as a new year approaches, searches for the current 'number-year' start declining quickly, while searches for the next 'number-year' rise. After

[4] Google Trends, Google Inc. Retrieved on 14 May 2019. Available at: https://trends.google.com/

each year has passed, the respective 'number-year' searches stabilise at low levels with long right tails, which indicates continuous interest in past events. This pattern is quite regular across the six years of data plotted in Figure 1. Throughout the same period, it can also be observed that searches for the present (current 'number-year') systematically outnumber searches for both the past and the future.

In this paper, I leverage cross-country variations in relative interest in the future rather than in the present, and use it as a proxy of future orientation. In particular, I propose a country-year measure of future orientation leveraging Google search data from 2010 to 2016.[5] This *Future Orientation Index* is computed as the ratio of the aggregated yearly volume of Google search queries for the '*next* year' to Google search queries for the '*current* year', corrected for differentials in internet adoption rates across countries. Formally, this can be written as:

$$FOI_{jt} = \frac{Google\ Search\ for\ t+1_{jt}}{Google\ Search\ for\ t_{jt}} \times \frac{\%\ InternetUsers_{jt} - min(\%\ InternetUsers)}{max(\%\ InternetUsers) - min(\%\ InternetUsers)} \quad (1)$$

where FOI_{jt} is the *Future Orientation Index* for a given year (t) and country (j). Equation (1) is composed of two terms. The first term captures the relative interest in the immediate '*future*' compared to in the '*present*'. In 2016, for example, future orientation is captured as the ratio of the aggregated country-level volume of searches for the keyword '2017' to the aggregated country-level volume of searches for the keyword '2016'. Relative to the measure devised by Preis et al. (2012), comparing searches for the present (t) and the future ($t + 1$), as proposed in Equation (1), has the advantage of yielding a measure that is directly interpretable in terms of a more theoretically relevant 'bias towards the future'.

3.2 Correcting for internet penetration

In Equation (1), the second term corrects raw 'future orientation' for cross-country differentials in internet penetration, as these differences might introduce biases into the representativeness of the data. The share of the population with internet access varies considerably across counties: in 2016, this figure ranged from 1.17% for Eritrea to 98.24% in Iceland. Wide differentials in internet access raise two issues: a) an *instability* bias, as short-run variations in internet access might make within-country year-to-year comparisons less meaningful; and b) a *selective adopter* bias, as internet usage and access are not orthogonal to individual-level characteristics that are likely to be correlated with future orientation, such as income and education. Therefore, especially in countries with low internet penetration,

[5] Google Trends, Google Inc. Retrieved from: https://trends.google.com/ between February 2016 and April 2019.

the observed volumes might be skewed towards specific demographics, such as towards individuals who are younger, more educated and more urban, and who might therefore display higher levels of future orientation compared to the baseline for the country.

Several methods have been proposed to address bias in non-representative internet samples (see Zagheni and Weber 2015 for a discussion). The correction proposed in Equation (1) equals one in the country-year with the highest proportion of internet users, and moves towards zero as the percentage of internet users declines. Therefore, the magnitude of the change in the raw future orientation measure for each country is inversely proportional to the rate of internet adoption: for high values of adoption, FOI_{jt} will not differ substantially from the raw future orientation measure. This follows from the assumption that the representativeness of the data increases as the internet adoption rate rises. Reflecting the further assumption of a negative monotonic relationship between individual-level future orientation and the likelihood of having internet access, the raw future orientation measure is reduced proportionately as the percentage of internet users declines. I repeat the procedure set out in Equation (1) for 200 countries and territories across the world in any given year from 2010 and 2016, and report summary statistics of this FOI in Table 2.

Because my weighting approach always returns low FOI values for those countries with low internet penetration rates, social and economic development factors that are related to modernisation, and are thus associated with both fertility and internet penetration rates, might lead to omitted variable bias when testing for the correlation between the future orientation measure and fertility at the country level. To test the robustness of my findings, I employ in this paper two sets of alternative future orientation measures. The first is the uncorrected FOI based on raw Google Search volumes. The second set of measures is obtained by multiplying my raw FOI by the correction factor proposed by Zagheni and Weber (2012). This correction factor (CF) can be written as:

$$CF = \frac{p_j(e^{-k} - 1)}{(e^{-kp_j} - 1)}$$

where p_j is the internet penetration rate by country (j) and k is a parameter that captures the intensity of the selective adopter bias.[6] According to Zagheni and Weber (2012, 351), "the parameter k determines how fast the selection bias increases with a decrease in Internet penetration rates. Low values of k imply that the selection bias is small, even at very low Internet penetration rates. Conversely, high values of k mean that the selection bias increases substantially when Internet penetration rates become lower". Thus, varying the value of k allows me to account for varying

[6] Zagheni and Weber (2012) additionally correct for the internet penetration by age and gender, thus using the formula $CF = \frac{p_{gaj}(e^{-k}-1)}{(e^{-kp_{gaj}}-1)}$, where g represents the gender-specific internet penetration rate and a represents the age-specific internet penetration rate.

Table 1:
Correlations by weighting procedure

	Raw future orientation
Preis et al. (2012)	1.000
CF, $k = 0.005$	0.972
CF, $k = 0.05$	0.476
CF, $k = 0.5$	0.290
CF, $k = 5$	0.282
CF, $k = 50$	0.282
FOI	0.279

degrees of (unobserved) self-selection in the sample. Following Zagheni and Weber (2012), I experiment with several values of the k parameter ($k = 0.005; k = 0.05; k = 0.5; k = 5; k = 50$).[7] Finally, I also use the naïve procedure proposed by Preis et al. (2012), who excluded countries with less than five million internet users from their sample. The correlation coefficients between these corrected FOI and the raw measure given by $FOI_{jt} = \frac{Google\ Search\ for\ t+1_{jt}}{Google\ Search\ for\ t_{jt}}$ are reported in Table 1.

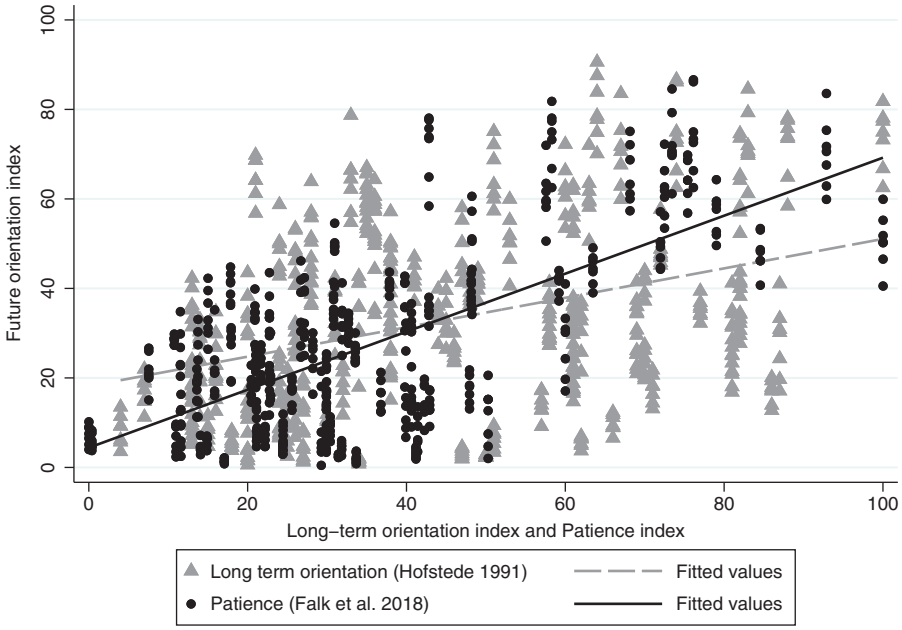
3.3 Validation of the Future Orientation Index

To further stress the appropriateness of my measure for capturing future orientation, I validate my index of country-level FOI against 'ground truth' data. In Figure 2, I plot the country-year FOI thus obtained with the Long-Term Orientation Index proposed by Hofstede (1991), and measured by Galor and Özak (2016) based on Wave 1 to 5 (1981–2009) of the World Value Survey (WVS), for 87 countries across the world.[8] This Long-Term Orientation Index (LTO) was constructed based on the following WVS item: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important?" As explained in Galor and Özak (2016, S93), "An individual is considered to have Long-Term Orientation if she answered 'Thrift, saving money and things' as an especially important quality children should learn at home". The country-level LTO also spans from zero to 100, and has been shown to correlate with national saving rates and other theoretically relevant macro-level outcomes (Hofstede et al. 2010, 38). The Pearson's coefficient for the correlation between FOI and LTO is 0.43.

[7] Notice that Zagheni and Weber (2015, 315) constrain the k parameter between the values 0.5 and 100.

[8] Galor and Özak (2016), Additional Materials – Dataset. Retrieved on 23 April 2019. Available at: https://www.aeaweb.org/articles?id=10.1257/aer.20150020.

Figure 2:
External validation of the Future Orientation Index



As can be seen from Figure 2, I also validate my FOI against a measure of time preference obtained from the Global Preference Survey (GPS), a large international survey covering 80,000 respondents in 76 countries that represent approximately 90% of the world's population (Falk et al. 2016, 2018).[9] In the GPS, the measure of time preference, or 'patience', is derived from the combination of responses to a quantitative and a qualitative survey: in the quantitative survey, respondents were confronted with a series of five interdependent binary choice tasks in which they had to decide between receiving a payment today or larger payments in 12 months. In the qualitative survey, respondents were asked to self-assess their 'willingness to wait' on an 11-point Likert scale, based on the following question: "How willing are you to give up something that is beneficial for you today in order to benefit more from that in the future?" The two sets of responses were then combined with a 71% weight assigned to the quantitative survey (Falk et al. 2018, 1653–1654). I find that the FOI, based on volume data from Google Search and corrected for internet adoption rates, correlates positively and strongly with the GPS's measure of patience (with a 0.70 Pearson correlation coefficient).

[9] Global Preference Survey (GPS). Retrieved on 23 April 2019. Available at: https://www.briq-institute.org

3.4 Identification strategy

In the next section, I test for the correlation between future orientation and fertility by fitting a standard OLS model with country and year fixed effects, where country-year TFR[10] is regressed on the FOI obtained from Equation (1). To account for confounders, I include in the model a range of country-level covariates: i.e., with the aim of controlling for a country's population structure, I include population size[11] and the age-dependency ratio.[12] I also control for a country's level of socio-economic development by adding a measure of gross domestic product (GDP),[13] expressed in constant 2010 United States dollars, as well as the widely used Human Development Index (HDI).[14] The HDI has been employed in demographic research to describe the transition from high to low fertility (Bongaarts and Watkins 1996), as well as to outline a recent reversal and the non-linearity of the HDI-fertility relationship (Myrskylä et al. 2009). Consistent with this literature, I allow for a non-linear effect of the HDI on fertility through the inclusion of a squared HDI variable. Furthermore, the inclusion of country-level fixed effects allows me to control for geographic characteristics that are stable across time, while the inclusion of year fixed effects allows me to account for the existence of idiosyncratic time factors that are related to events that shift interest globally.

Despite using information on internet adoption to correct the raw FOI obtained from the Google Trends tool, I also include the levels of internet adoption in the country as an additional explanatory variable for fertility (Billari et al. 2019). Unfortunately, not all of these data are available for all of the countries for which the FOI can be computed. In the next section, I present results using all data for all countries in the sample, including for those countries for which some values are missing across the set of controls. Thus, in order to retain the highest statistical power available, the models are tested on marginally varying samples. However, the results are robust when listwise deletion is employed, and the models are estimated only on the subset of countries for which data for all controls and all years are available (not shown). Table 2 presents summary statistics for the variables employed in the following analysis. All analyses are run in STATA v.16/SE.

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[10] World Bank - Fertility rate, total (births per woman). Retrieved on 8 February 2016. Series updated 19 April 2019. Available at: https://data.worldbank.org/indicator/SP.DYN.TFRT.IN

[11] World Bank - World development indicators; Population, total. Retrieved on 21 April, 2019. Available at: https://data.worldbank.org/indicator/SP.POP.TOTL

[12] World Bank - World development indicators; Age dependency ratio (% of working-age population). Retrieved on 23 April 2019. Available at: https://data.worldbank.org/indicator/sp.pop.dpnd

[13] World Bank - World development indicators; GDP (constant 2010 US$). Retrieved on 11 February 2016. Series updated 12 April 2019. Available at: https://data.worldbank.org/indicator/NY.GDP.MKTP.KD

[14] United Nations Development Programme – Human Development Reports; Human Development Index. Retrieved on 9 February 2016. Series updated 22 April 2019. Available at: http://hdr.undp.org/en/data

Table 2:
Summary statistics

	Mean	Sd	Min	Max	*N*
Outcome variables					
Total fertility rate (TFR)	2.84	1.43	1.06	7.48	1328
Explanatory variable					
Future Orientation Index (FOI)	24.92	20.90	0	100	1362
Controls					
Internet penetration	42.36	29.08	0.25	98.32	1368
Age-dependency ratio	59.41	18.55	16.45	111.77	1290
Population (M)	35.72	136.18	0.01	1378.66	1395
Gross domestic product (GDP $M)	369343	1413891	1.69	1853.31	1344
Human Development Index (HDI)	0.69	0.15	0.31	0.95	1309

4 Results

4.1 Empirical evidence on cross-country future orientation

I re-express the FOI obtained from Equation (1) on a zero (maximum present bias) to 100 (maximum future orientation) scale, and plot on a world map the country averages for the period 2010–2016. Overall, the mean FOI value is 24.92. Even though in all years the searches for the current 'number-year' exceed the searches for the future 'number-year' by 9.49 times on average, the variation in the FOI is fairly large, with a standard deviation of 20.90. The country scoring the highest on the future orientation measure is Lichtenstein (85.79), while the country scoring the lowest is Somalia (0.79). Just as countries vary greatly in their overall economic development and in their stage in the demographic transition, they differ in their future orientation levels as well. The average FOI value for countries classified as 'high-income' by the World Bank is 48.97, whereas the average FOI for 'low-income' countries is only 4.54. Looking at Figure 3, it is also possible to qualitatively observe that the countries with the highest levels of future orientation (Germany, Japan, South Korea) are also characterised by lowest-low fertility, while the countries with high TFRs, such as Sub-Saharan African countries, also tend to have lower levels of future orientation.

In Figure 4, I present some descriptive evidence on the association between the TFR and the FOI from 2010 to 2016 for 200 countries and territories across the world (black circles). The evidence indicates that the TFR quickly declines as the FOI increases. However, this correlation becomes flat when moving towards higher levels of future orientation (lower levels of present bias). In Figure 4, I also separately plot the two elements that constitute the FOI; i.e., the raw search ratio and

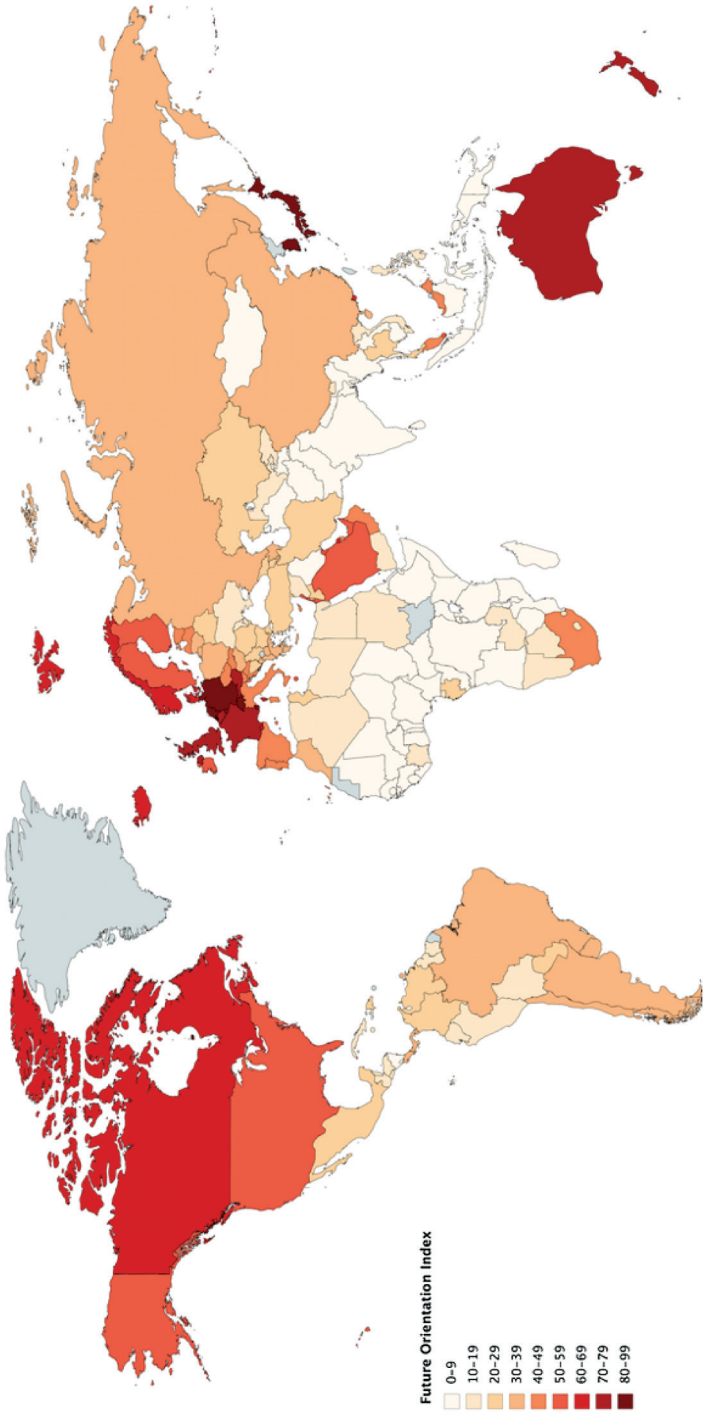
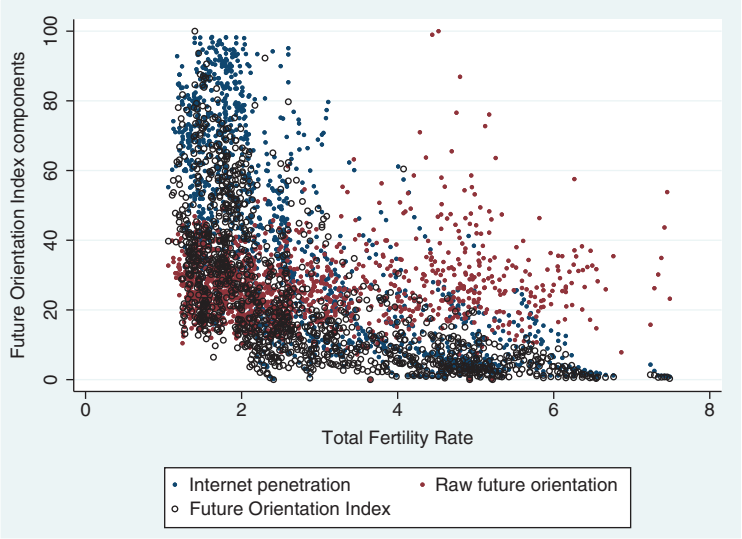


Figure 3:
Future Orientation Index across the world, 2010–2016 averages

Figure 4:
Future orientation and total fertility rate

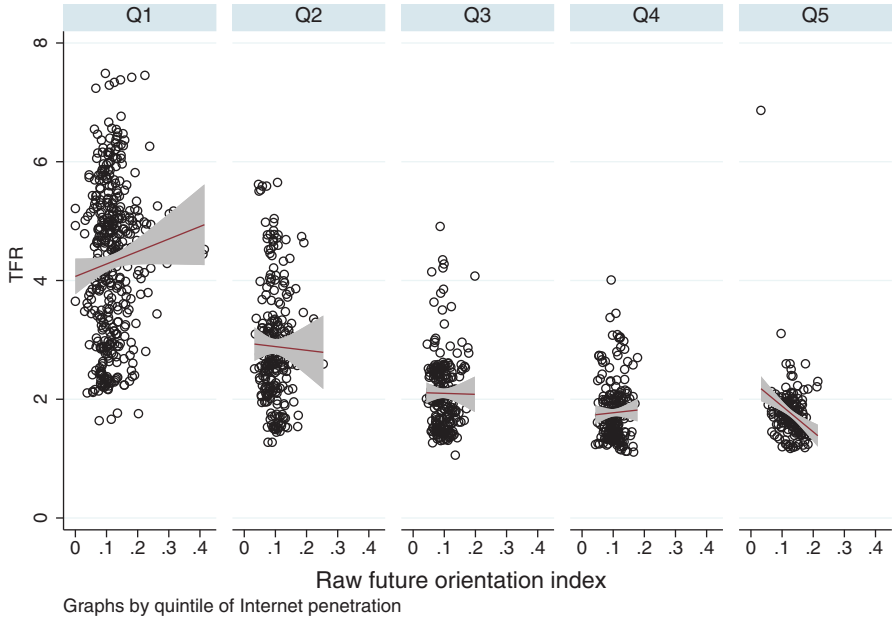


the standardised levels of internet penetration. When looking at these two factors separately, it appears that the shape of the association between the FOI and the TFR is imposed by the distribution of internet penetration levels, while the raw search ratio shows no clear association with the TFR.

In order to verify whether the association between the FOI and the TFR is an artefact created by the way in which the FOI is computed, I plot in Figure 5 the raw search ratio $\left(\frac{Google\ Search\ for\ t{+}1_{jt}}{Google\ Search\ for\ t_{jt}}\right)$ against the TFRs for each country and year by levels of internet penetration ($\leq 20\%$, $> 20- \leq 40\%$, $> 60- \leq 70\%$, and $> 80 - 100\%$). As was discussed in Section 3.2, my correction approach assumes that the representativeness of the data increases with the level of internet adoption. Indeed, at low levels of internet penetration (Internet $< 20\%$) the raw Future Orientation Index has a higher degree of variability ($min = 0$; $max = 0.41$; sd = 0.54), and the association between this search measure and the TFR has a positive slope.[15] However, at the highest level of internet penetration, a significant negative association seems to appear ($r = -0.2048$, $p = 0.0069$). In the regression analysis, I experiment with different correction approaches to relax the assumptions driving the correction of Equation (1).

[15] I thank an anonymous reviewer and the editors for this part of the analysis.

Figure 5:
Correlation between TFR and raw search ratio, by levels of internet penetration



4.2 Regression analysis

In Table 3, I show results for the effects of future orientation on total fertility rates. Column (1) regresses the TFR on the FOI only: in line with *Hypothesis 1*, the coefficient of this relationship is found to be negative and significant at the 0.001 level. The size of the coefficient implies that a one-unit increase in the FOI leads to a 0.04 decrease in the TFR at the country-year level – or that a standard deviation increase in the FOI causes the TFR to decline by 0.8 points on average, ceteris paribus. This result is robust to the inclusion of year- and country-fixed effects. However, the inclusion of these controls shrinks the size of the coefficient, which becomes only marginally significant (Table 3 Column 3). The introduction of country-year levels of internet penetration ($\beta_{\text{internet}} = 0.00$, $p = 9.65$) in the regression equation (Table 3 Column 4) decreases the size of the beta coefficient, which also becomes better defined in statistical terms (statistical significance at the 0.001 level).

This result implies that failing to include internet penetration repressed the effect of future orientation on fertility, as the level of internet penetration appears to be negatively correlated with the FOI (implicitly confirming the selectivity of internet users at low levels of internet penetration) and positively correlated with

Table 3:
Regression analysis: TFR and FOI; world 2010–2016

	Total fertility rate						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
	Pane a. Linear model						
FOI	−0.044***	−0.044***	−0.001***	−0.003***	−0.002***	−0.002***	−0.002***
	(−30.40)	(−30.61)	(−7.35)	(−5.58)	(−4.93)	(−5.25)	(−4.06)
	Pane b. Non-linear model						
FOI	−0.127***	−0.127***	−0.003**	−0.009***	−0.002[6]*	−0.006***	−0.004***
	(−32.61)	(−32.76)	(−2.88)	(−7.02)	(−6.54)	(−6.26)	(−4.04)
FOI^2	0.001***	0.001***	0.000***	0.000***	0.000***	0.000***	0.000*
	(22.36)	(22.40)	(2.33)	(4.78)	(4.62)	(4.07)	(2.24)
Dependency	NO	NO	NO	NO	YES	YES	YES
Population	NO	NO	NO	NO	YES	YES	YES
GDP	NO	NO	NO	NO	NO	YES	YES
HDI	NO	NO	NO	NO	NO	YES	YES
HDI^2	NO	NO	NO	NO	NO	NO	YES
Internet	NO	NO	NO	YES	YES	YES	YES
Year F.E.	NO	YES	YES	YES	YES	YES	YES
Country F.E.	NO	NO	YES	YES	YES	YES	YES
N	1313	1313	1313	1313	1285	1250	1250

Note: *t* statistics in parentheses; $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{+}p < 0.10$.

the TFR. In Table 3 Column 5, I control for the population structure by introducing both the population size and the age-dependency ratio. The inclusion of these additional variables ($\beta_{population} = -0.00$, $p = -1.06$; $\beta_{dependency} = 0.02$, $p = 18.81$) does not alter the significance of the correlation between the FOI and the TFR, while marginally shrinking the size of the correlation coefficient. In Column 6, I control for socio-economic development by introducing variables capturing the GDP ($\beta_{GDP} = 0.00$, $p = 2.11$) and the HDI ($\beta_{HDI} = -9.54$, $p = -10.68$); while in Column 7, I allow for a non-linear relationship between the TFR and the HDI ($\beta_{HDIsq} = 7.23$, $p = 10.70$). The correlation between the FOI and the TFR is robust to the inclusion of these controls. Based on the model of Column 6, I conclude that a one-standard-deviation increase in the FOI decreases the TFR by 0.04 points on average.

I also run a set of regressions fitting a non-linear model of future orientation by allowing a FOI squared (FOI^2) independent variable to enter the TFR regression (Table 3 Pane b). Even in these models, the FOI is negatively correlated with the TFR. However, the size of the estimated coefficient is noticeably larger across all regressions. Additionally, and consistent with the descriptive evidence presented in Figure 4, I find that at higher levels of future orientation, the correlation with the

Table 4:
Alternative correction approaches

	Total fertility rate						
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
	Pane a. Linear model						
FOI	0.022	0.021	0.027	−0.081^{+}	−0.026***	−0.011***	−0.011***
	(0.68)	(0.57)	(0.37)	(−1.77)	(−3.80)	(−4.03)	(−4.03)
	Pane b. Non-linear model						
FOI	−0.149^{+}	−0.310**	−0.034	−0.034	−0.047***	−0.021***	−0.021***
	(−1.75)	(−2.98)	(−1.63)	(−0.39)	(−3.56)	(−3.98)	(−3.98)
FOI^2	0.235*	0.471***	1.76^{+}	0.071	0.003^{+}	0.001*	0.001*
	(2.16)	(3.38)	(1.89)	(0.64)	(1.85)	(2.19)	(2.19)
Correction							
None	✓						
Users > 5M		✓					
CF, $k = 0.005$			✓				
CF, $k = 0.05$				✓			
CF, $k = 0.5$					✓		
CF, $k = 5$						✓	
CF, $k = 50$							✓
N	1250	1182	1250	1250	1250	1250	1250

Note: *t* statistics in parentheses; $^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{+}p < 0.10$. All models include all controls.

TFR becomes positive. This result is consistent and significant across all models, even when allowing for non-linear effects of socio-economic development through the inclusion in the model of the HDI and the squared HDI, as is done in Column 7 (significant at the 0.05 level). These results are robust to the inclusion of the FOI with a one-year lag as an explanatory variable (not shown). Overall, these results appear to confirm that future orientation is negatively associated with total fertility, but that this relationship ceases to be negative at high FOI levels.

In Table 4, I replicate the model of Equation (1) using alternative future orientation measures. I first experiment using the raw Google Search ratio of 'next year' to 'current year' volumes. In the linear model, the correlation between the raw Google search ratio and the TFT is not significant (Column 1 pane a). However, when allowing for non-linear effects in the relationship between the TFR and future orientation, I observe a negative coefficient significant at the 0.10 level for the FOI, and a positive coefficient significant at the 0.05 level for the FOI^2 (Column 1 pane b). These results do not change when the sample is restricted to those country-years with internet user numbers above five million, as proposed by Preis et al. (2012). On the other hand, the results from four out of the five correction factors proposed by Zagheni and Weber (2012) confirm that there is a significant and negative correlation

between the FOI and the TFR in the linear model (Columns 4 to 7). Moreover, the sign and the significance of the coefficients are robust in the non-linear model as well – with the exception of $k = 0.05$.

5 Discussion and Conclusions

In this paper, I have investigated the relationship between a measure of 'future orientation' and total fertility rates using Google Trends web search data. Before discussing my findings, it should be noted that the study has a number of limitations stemming from the use of online search data. A first general limitation is that the Google Trends volumes, which were used as an explanatory variable, were retrieved on multiple occasions at different points in time from April 2016 to 2019 (see footnote 6 above). This introduces a degree of sampling noise in the data-generating process. In fact, Google Trends employs a rolling sampling procedure that returns the same result within each day, but slightly different results on different days. Carrière-Swallow and Labbé (2013, 291) found that the distribution of measurements has a standard deviation of 5.8% and a kurtosis above 10. The estimates presented in this paper are based on the assumption that this measurement variation is random, and is, therefore, captured in the error term of my regression models.

An additional limitation stemming from my use of Google Trends volumes as a predictor is that internet penetration levels vary significantly across countries and time. Throughout the paper, I have repeatedly noted that differences in levels of internet penetration may affect the reliability of my future orientation estimates. I have also proposed a simple method for correcting for cross-country internet penetration, and used this corrected Future Orientation Index in my regression models. However, my correction approach relies on two assumptions: first, that the representativeness of digital data increases with the level of internet adoption; and, second, that there is a negative monotonic relationship between individual-level future orientation and the likelihood of having internet access. To relax these assumptions, I ran a set of robustness checks that employ alternative correction methods, based on Zagheni and Weber (2012) and Preis et al. (2012). I also used a raw, uncorrected measure of future orientation as the main explanatory variable. The results of these models generally confirmed the robustness of my main findings.

Finally, it should be noted that even within countries with high levels of internet penetration, there are often large divides in digital access across different social groups (see, e.g., Garcia et al. 2018; Fatehkia et al. 2018 for overviews of gender inequalities); and that even in those countries where the population's level of access to the internet is relatively equal, people with different socio-economic characteristics tend to use Google with different intensities, and thus bear different weights in the data-generating process (Ragnedda and Muschert 2013). To address this issue, Zagheni and Weber (2015) proposed further correcting raw digital trace estimates by accounting for differential levels of internet access by gender and age

within each country. Because of a lack of appropriate data, the internet penetration corrections that I employed in this paper did not account for these additional sources of bias.

Despite these significant limitations, I found that my digital trace-based estimates of future orientation are consistent with Hofstede's (1991) Long-Term Orientation Index and with evidence from Falk et al.'s (2018) Global Preference Survey, which includes high-quality experimental and self-reported measures of time preferences. However, while these latter measures are high-cost, low-frequency indicators because they are based on the availability and the deployment of large-scale social surveys across countries, the Future Orientation Index that I presented is a low-cost, high-frequency measure that allows for replicability and broader worldwide coverage. Estimates from the United Nations' International Telecommunication Union[16] indicate that around 42% of the world's population had internet access throughout this time period. With the exception of China, Google is the preferred search engine in every country, with a 90.9% share of the global online search engine market.[17] Based on this figure, it can be estimated that the Google Trends data employed in my paper capture the online search behaviour of about 2.3 billion individuals in 200 countries and territories, or 31% of the world's population (see Bail et al. (2019) for analogous estimates and a discussion).

Using this cross-national longitudinal dataset, I found evidence of a negative correlation between future orientation and total fertility rates at the country level. In a linear regression model, this relationship is robust to country and year fixed effects, and to the inclusion of several country-level controls. Based on the full model, I estimated that on average, a one-standard-deviation increase in the FOI is associated with a 0.04-point decrease in the TFR. I also tentatively documented a non-linearity in this relationship: at high levels of future orientation, the correlation between the FOI and the TFR flattens out.

In the literature, several other studies have found a similar J-shaped relationship between the TFR and variously conceived measures of development. Myrskylä et al. (2009) found that while increases in development (HDI) generally reduce fertility, at high levels of development, further increases in the HDI reverse the decline. By contrast, Luci-Greulich and Thévenon (2014) as well as Esping-Andersen and Billari (2015) pointed to the role of gender equality, arguing that after a certain level of development, the ongoing female revolution reverses fertility decline. Finally, Aassve et al. (2016) rationalised such trends by referring to generalised social trust, and its role in moderating the fertility implications of women's educational expansion. Rather than arguing that future orientation represents an alternative

[16] World Bank data based on the International Telecommunication Union, World Telecommunication/ICT Development Report and database. Internet users are defined as individuals who have used the internet in the last three months from any device, including a computer, a mobile phone, a personal digital assistant, a gaming machine, or a digital TV. Retrieved on 22 April 2019. Available at: https://datacatalog.worldbank.org/internet-users-100-people-2

[17] Retrieved from Statcounter.com on 27 April 2020.

theoretical paradigm, I propose that considering the role played by time preferences can add another theoretical micro-foundation to the mechanisms that link individual fertility decisions to institutional factors that operate at the macro level.

For example, at the macro level, an initial implication of the quantity-quality trade-off with hyperbolic discounting is that for any level of present bias, a unit increase in the cost of investing in quality leads to lower desired fertility. Thus, education represents a *commitment technology*; i.e., a device that exogenously constrains the future decisions of households by introducing a lower bound to the resources devoted to investing in quality. This implies that households that have the same level of present bias, but that are subject to different levels of required investments in human capital, generally as a function of the degree of development in a country or of specific institutional settings, will have very different fertility outcomes. A second implication concerns the role that economic institutions, such as capital markets, might play in altering the time horizon of prospective parents. By shifting the costs of childrearing to the future, a fully functioning capital market allows households to increase both quality and quantity – the only two factors that jointly enter the household's utility at the third and final period – at an intertemporal rate of substitution equal to the interest rate.

At the micro level, high rates of discounting have also been linked to several suboptimal behaviours, such as under-saving (Strotz 1955; Laibson 1997), smoking (Gruber and Kőszegi 2002), and having an unhealthy diet (Barlow et al. 2016), with particularly adverse implications for poor households in developing countries (Banerjee and Mullainathan 2010). As I discussed above, if households cannot anticipate future alterations in preferences, those engaged in hyperbolic discounting might have a higher-than-optimal number of children, which would result in a lower-than-optimal level of quality. Thus, examining the role present bias plays in fertility decisions might shed some light on the mechanisms that underlie the observed empirical correlation between household size and poverty (Lanjouw and Ravallion 1995). According to Haushofer and Fehr (2014, 866), poverty has distinct neurological effects, including a higher aversion to risk and a stronger preference for short-term rewards.

This paper represents only a tentative first step towards the development of a research programme that incorporates the role that future orientation plays in childbearing decisions. Furthermore, limitations in the currently available methods for extracting comparably meaningful signals across regions with different levels of internet penetration, and the nature of this paper's empirical approach, do not allow me to make any causal claims regarding the relationship between the TFR and the FOI. However, while research on fertility has had the advantage of relying on data that are available across countries and time, including objective macro- and micro-level determinants, measures of more subjective factors, such as those related to future orientation, have so far been elusive, especially across time and space. With this paper I have argued that digital trace data could prove helpful in this research domain. However, the use of digital traces in demographic and fertility research

presents a number of challenges, some of which I discussed in this paper, that should be carefully and openly debated.

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DATA & TRENDS

Vienna Yearbook of Population Research 2020 (Vol. 18), pp. 267–284

Selected Wittgenstein Centre databases on fertility across time and space

Kryštof Zeman[1,*] ***and Tomáš Sobotka***[1]

This contribution provides a brief structured overview of selected open-access databases and data websites developed by the Wittgenstein Centre for Demography and Global Human Capital, in some cases in cooperation with partner institutions or based on the data supplied by partner institutions. The presented databases primarily focus on fertility data or have a broader focus, but provide detailed coverage of fertility data. These databases also showcase the breadth and scope of fertility-related research at the Wittgenstein Centre, as they range from detailed data that focus on one country and even one city (*Birth Barometer* for Austria and Vienna), to data that provide comprehensive coverage of one continent (*European Demographic Data Sheet*), to databases that offer global coverage (*Human Fertility Collection*, *Wittgenstein Centre Human Capital Data Explorer*). These databases also cover very different time periods, with the oldest data in the *Human Fertility Collection* pertaining to 1751, and the *Wittgenstein Centre Data Explorer* featuring projections up to 2100.

We review the following six databases:

- Human Fertility Database (https://www.humanfertility.org)
- Human Fertility Collection (https://www.fertilitydata.org)
- Birth Barometer – Monitoring fertility in Austria (http://www.birthbarometer.at)
- European Demographic Data Sheet (http://www.populationeurope.org)
- Wittgenstein Centre Human Capital Data Explorer (http://dataexplorer.wittgensteincentre.org)
- Cohort Fertility and Education Database (http://www.cfe-database.org)

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1 Human Fertility Database

https://www.humanfertility.org

The *Human Fertility Database (HFD)* is a joint project of the Max Planck Institute for Demographic Research (MPIDR) in Rostock, Germany, and the Vienna Institute of Demography (VID) in Vienna, and is based at the MPIDR. The HFD provides free and user-friendly access to detailed and high-quality data on period and cohort fertility, facilitating research on changes and inter-country differences in fertility in the past and in the modern era.

What's special about the HFD database?

The HFD is entirely based on official vital statistics, and places great emphasis on data checking and documentation, and on facilitating data comparability across time and countries by applying a uniform methodology. When available, the HFD also incorporates data on fertility rates by birth order, including parity-specific fertility tables that are not readily accessible from other sources.

What data are covered in the HFD?

Currently, the HFD contains data for 42 countries and regions. For each country, the HFD aims to collect the longest possible continuous time series. The length of the currently available datasets varies across countries. The longest time series of data stem from Sweden (dating to 1891).

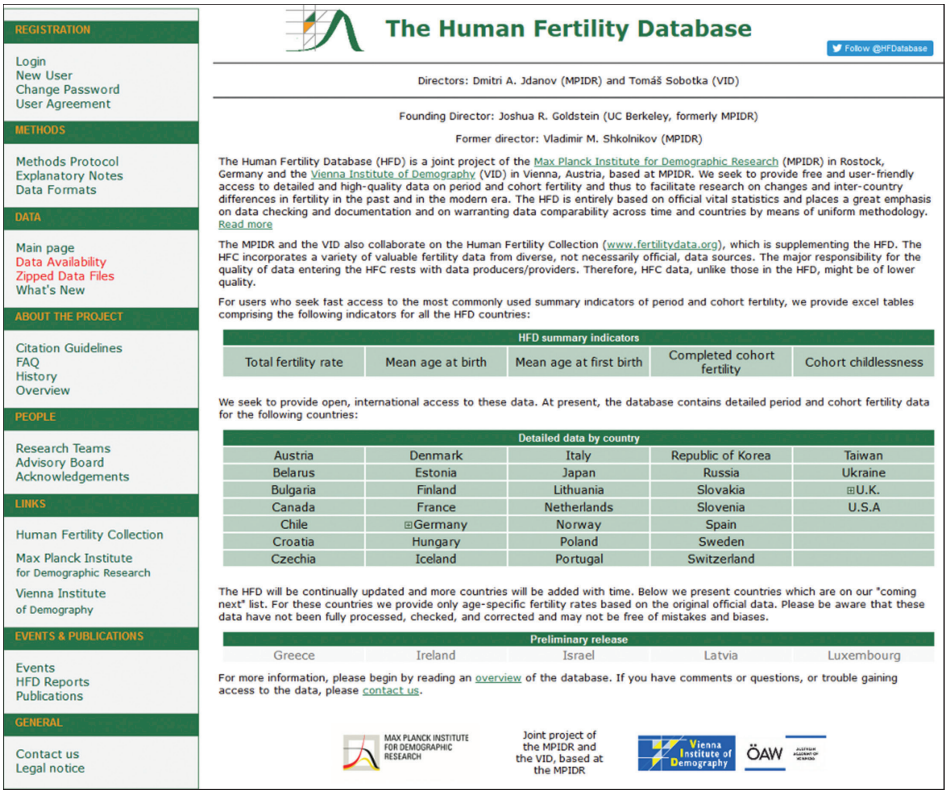
What's new in the Human Fertility Database?

Besides continuously expanding its data coverage to incorporate the latest data, the HFD is evolving to respond to the research needs of different users, and to reflect changing fertility trends.

- Adding HFD summary indicators. For users who do not need detailed data and appreciate having quick access to key indicators across all of the countries and periods covered, we are adding easily accessible Excel files with main HFD Summary Indicators, which are available without registration. In 2020, these indicators are being expanded to cover parity distribution among women born since 1935, and the tempo-adjusted TFR developed by Bongaarts and Feeney (1998).
- Adding the Short-Term Fertility Fluctuations (STFF) time series and a visualisation toolkit. The COVID-19 pandemic is likely to affect fertility rates. To give users initial insight into the unfolding changes, we are adding time series of the most recent monthly data on the number of live births, which will

be updated each month. This monitoring should be launched in early 2021, in time to reflect the first effects of COVID-19 on births. This initiative follows a similar data series on Short-Term Mortality Fluctuations (STMF), developed in the Human Mortality Database (https://www.mortality.org).

- Data for more countries are gradually being incorporated into the database. At present, five countries are in the "Preliminary Release" category, with a limited range of preliminary data provided to the users: Greece, Ireland, Israel, Latvia and Luxembourg.



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User Agreement
METHODS
Methods Protocol
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The Human Fertility Database (HFD) is a joint project of the Max Planck Institute for Demographic Research (MPIDR) in Rostock, Germany and the Vienna Institute of Demography (VID) in Vienna, Austria, based at MPIDR. We seek to provide free and user-friendly access to detailed and high-quality data on period and cohort fertility and thus to facilitate research on changes and inter-country differences in fertility in the past and in the modern era. The HFD is entirely based on official vital statistics and places a great emphasis on data checking and documentation and on warranting data comparability across time and countries by means of uniform methodology. Read more

The MPIDR and the VID also collaborate on the Human Fertility Collection (www.fertilitydata.org), which is supplementing the HFD. The HFC incorporates a variety of valuable fertility data from diverse, not necessarily official, data sources. The major responsibility for the quality of data entering the HFC rests with data producers/providers. Therefore, HFC data, unlike those in the HFD, might be of lower quality.

For users who seek fast access to the most commonly used summary indicators of period and cohort fertility, we provide excel tables comprising the following indicators for all the HFD countries:

HFD summary indicators				
Total fertility rate	Mean age at birth	Mean age at first birth	Completed cohort fertility	Cohort childlessness

We seek to provide open, international access to these data. At present, the database contains detailed period and cohort fertility data for the following countries:

Detailed data by country				
Austria	Denmark	Italy	Republic of Korea	Taiwan
Belarus	Estonia	Japan	Russia	Ukraine
Bulgaria	Finland	Lithuania	Slovakia	⊞U.K.
Canada	France	Netherlands	Slovenia	U.S.A
Chile	⊞Germany	Norway	Spain	
Croatia	Hungary	Poland	Sweden	
Czechia	Iceland	Portugal	Switzerland	

The HFD will be continually updated and more countries will be added with time. Below we present countries which are on our "coming next" list. For these countries we provide only age-specific fertility rates based on the original official data. Please be aware that these data have not been fully processed, checked, and corrected and may not be free of mistakes and biases.

Preliminary release				
Greece	Ireland	Israel	Latvia	Luxembourg

For more information, please begin by reading an overview of the database. If you have comments or questions, or trouble gaining access to the data, please contact us.

MAX PLANCK INSTITUTE FOR DEMOGRAPHIC RESEARCH

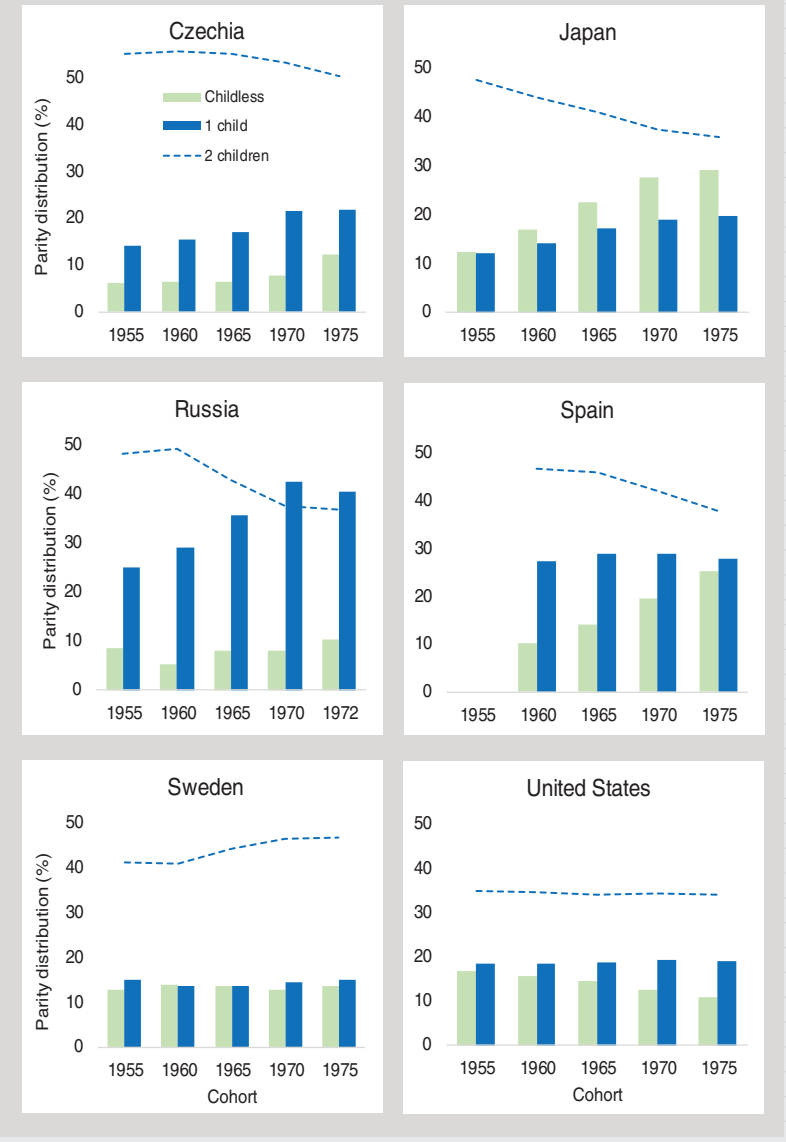
Joint project of the MPIDR and the VID, based at the MPIDR

Vienna Institute of Demography

ÖAW

Highlight: Changing parity distribution: childlessness vs. having one child

One of the special features of the HFD is its focus on fertility data by birth order, including cohort parity distributions. Here we illustrate their use by plotting the changes in the share of women who are childless, have one child, or have two children by age 42. We look at six countries with different levels of and trends in parity distribution among women born in 1955–1975.



2 Human Fertility Collection

https://www.fertilitydata.org

The *Human Fertility Collection (HFC)* is a joint project of the Max Planck Institute for Demographic Research (MPIDR) in Rostock, Germany, and the Vienna Institute of Demography. The HFC has been designed to supplement the Human Fertility Database (HFD) and to incorporate a variety of international fertility data that are valuable for fertility research, but that do not meet all of the quality standards of the HFD.

What's special about the HFC database?

The HFC features estimates from national statistical offices and many other data sources, including survey data, statistical and scientific publications and data reconstructed by individual researchers or research teams (e.g., the European Demographic Observatory – ODE). This flexibility allows the HFC to expand the geographical coverage of the data to less developed parts of the world, and to feature historical data and estimates. At present, the HFC includes the following period fertility data specified for all birth orders combined and by birth order (when available) in a standardised format: age-specific fertility rates (ASFR), cumulative fertility rates, total fertility rates and mean ages at birth.

What data are covered in the HFC?

Data for 101 countries and areas are currently provided in the HFC. Data for all birth orders combined can be found from 1751 onwards (Sweden), and the earliest year for which birth order-specific data are available is 1917 (USA). For a selected number of countries, these data are available for males as well as for females.

What's new in the Human Fertility Collection?

- The latest data are being updated faster than in the Human Fertility Database. The fertility rates for the most recent available period are added soon after they are published. Currently, data for 18 countries are available up to 2019.
- Data for more countries are being gradually incorporated. Data for non-European countries are being added as well, including for Costa Rica, Indonesia, Tunisia and Sri Lanka.
- The database also aims to cover the fertility of men. Data on male fertility rates by age for 19 countries were added in November 2019.
- Other data dimensions are planned in the future, including fertility of migrants and fertility rates for sub-national regions.

Human Fertility Collection

Home | Methods | News | **Data** | Terms | Credits | Contact | FAQ

At present in the HFC, female fertility data are provided for **101 countries and areas** and male fertility data are available for **19 countries and areas**. The HFC data can be downloaded either as a single zipped file for all countries or by country. Data for all birth orders combined and data by birth order are available for download separately. Male fertility data are also downloadable separately. Please note that by downloading the HFC data you agree to be bound to *the terms of the user agreement*.

Zipped data files

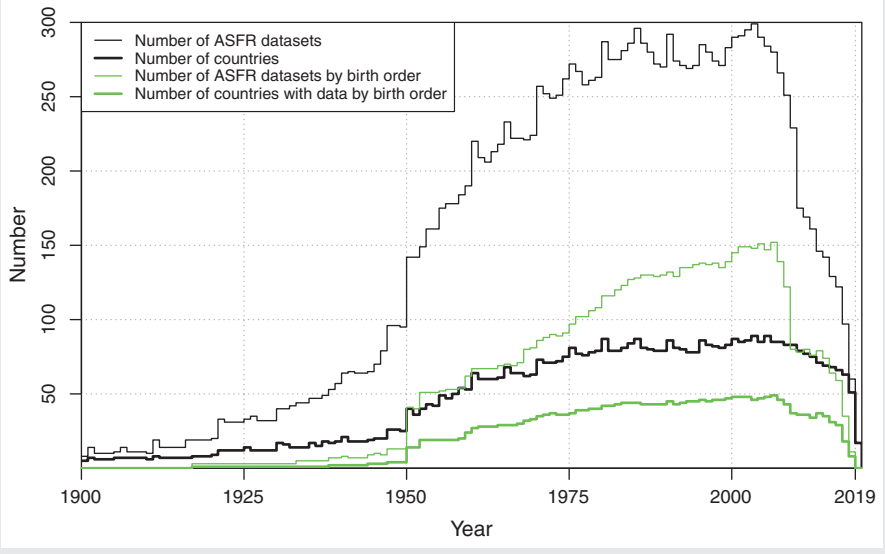
Indicator	All birth orders combined, females	By birth order, females	Males
ASFR and CPFR, standardized age scale	All HFC data (7Mb)	All HFC data (11Mb)	All HFC data (248.7Kb)
ASFR, original age scale	All HFC data (3.3Mb)	All HFC data (4.9Mb)	All HFC data (158.8Kb)
TFR and mean age at birth	All HFC data (166Kb) [graphs]	All HFC data (217.7Kb)	All HFC data (5.4Kb) [graphs]

References *Notes* *Codes used in HFC*

Data by country

Albania	Cuba	Indonesia	Montenegro	Slovenia
American Samoa	Cyprus	Iran	Netherlands	Spain ◦ *males*
Argentina	Czechia	Ireland	New Zealand	Sri Lanka
Armenia	Czechoslovakia	Israel	North Macedonia	Sweden ◦ *males*
Aruba	Denmark ◦ *males*	Italy ◦ *males*	Norway	Switzerland
Australia ◦ *males*	Egypt	Japan ◦ *males*	Pakistan	Taiwan ◦ *males*
Austria	Estonia ◦ *males*	Jordan	Palau	Thailand

Highlight: The largest collection of period fertility data across time (1751–2019) and space (101 countries).



3 Birth Barometer – Monitoring fertility in Austria

http://www.birthbarometer.at

The *Birth Barometer (Geburtenbarometer* in German) features up-to-date data, graphs and analyses on fertility trends in Austria. Six individual presentations provide in-depth coverage of period and cohort fertility, fertility timing, migrant fertility, male fertility and fertility in Vienna. The underlying data are available for download in a single Excel file.

What's special about the Birth Barometer?

The Birth Barometer, which started in 2005, has been completely redesigned and expanded. The website now covers a wider range of topics, including male fertility and migrant fertility. In addition to the German version of the website, the Birth Barometer is now available in English in order to provide information and data to an international audience. The main indicators are computed in both an annual and a monthly (or quarterly) format. The fertility trends are covered in topical presentations that are based on simple graphs, short accompanying texts and publicly accessible datasets. All indicators are computed from the data provided by Statistics Austria.

What data are covered in the Birth Barometer?

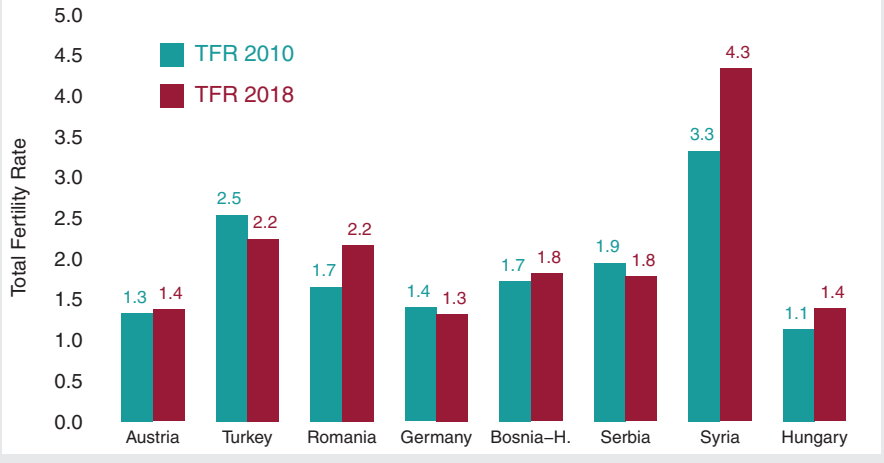
The Birth Barometer focuses on fertility in Austria and Vienna. It features long time series (starting in 1951) of the main fertility indicators, as well as more detailed fertility indicators from 1984 onwards. Monthly data series are available from 2002.

What's new in the Birth Barometer?

In 2019, the format of the Birth Barometer has been changed to make it more accessible to the wider public and to journalists. The presentations now offer a short overview of data, indicators and trends; with an emphasis on data visualisation and short explanatory texts. The topical presentations cover a range of issues, including recent fertility trends, cohort fertility rates, male fertility, migrant fertility, fertility timing and fertility in Vienna. The core indicators will be updated every year. In the future, the Birth Barometer will provide an expanded coverage of migrant fertility by country of birth. Data that reflect the impact of the COVID-19 pandemic on fertility and fertility intentions will be added as well.

Highlight: Total fertility rate by country of birth of the mother, 2010 and 2018

Almost 29,000 children born in Austria in 2018 had a mother born in another country, while 57,000 had an Austrian-born mother. There are large differences in the fertility rates of migrant women coming from different countries. Women born in Germany and Hungary have fertility rates that are almost identical to those of Austrian-born women. Women born in south-eastern Europe and Turkey have higher fertility rates, with their TFR reaching around two births per woman. Women born in Syria had very high and increasing fertility rates between 2010 and 2018. This sharp rise in fertility can be attributed to high fertility among refugee women soon after their arrival in the host country.



4 European Demographic Data Sheet

http://www.populationeurope.org

The *European Demographic Data Sheet* (EDS) has been published biannually since 2006. It reviews, explores and visualises recent population trends in Europe. The Data Sheet also provides a snapshot of the current research of the Wittgenstein Centre for Demography and Global Human Capital and collaborating researchers, including the key results of population projection scenarios. The online version provides an expanded selection of maps and ranking tables, as well as theme-focused texts and figures.

What's special about the Data Sheet?

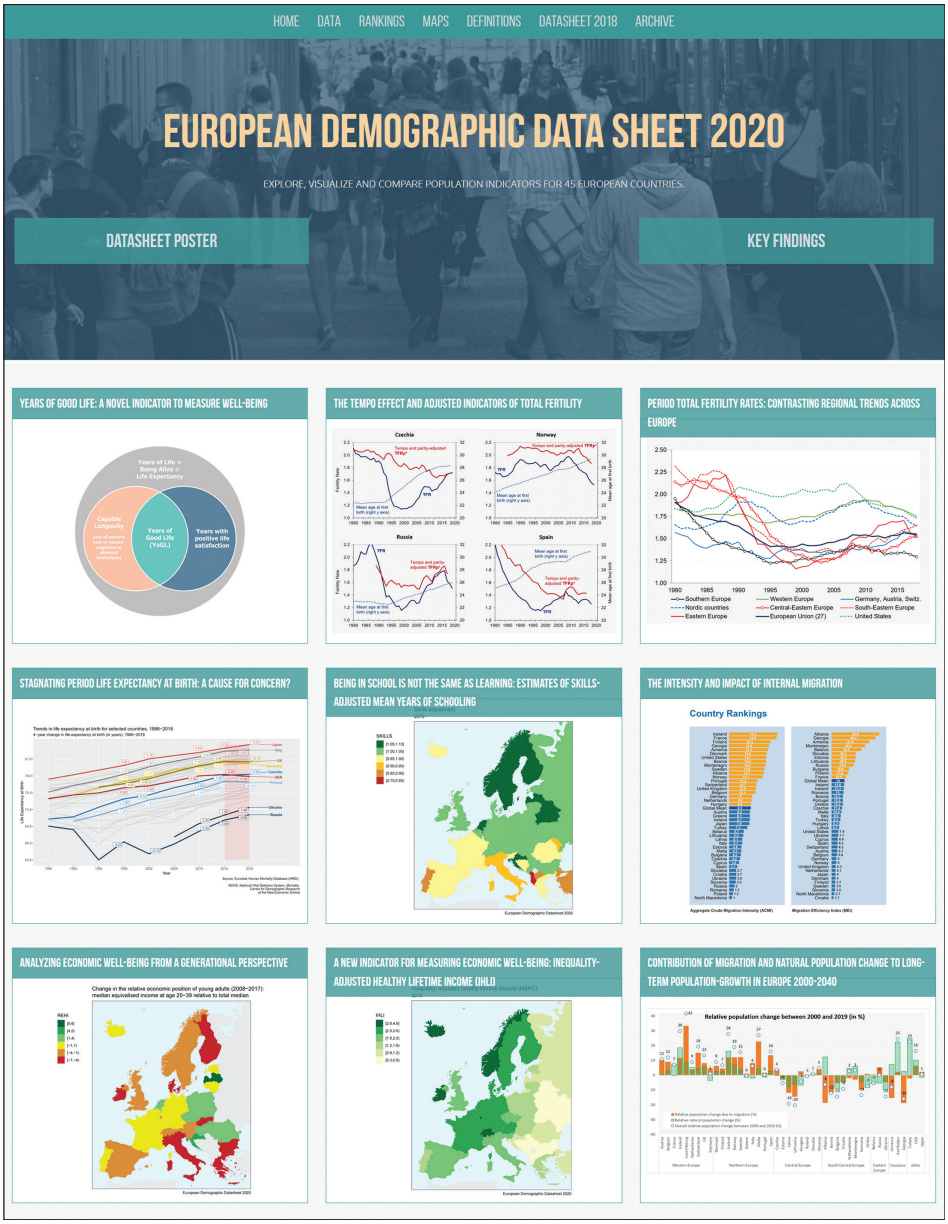
The Data Sheet covers data for all countries in Europe with a population of more than 100,000 people. It features a range of fertility indicators, including several indicators that are not available for all European countries from other sources, such as tempo-adjusted TFRs, completed cohort fertility rates and childlessness.

What data are covered in the EDS?

The European Demographic Data Sheet (EDS) covers 45 European countries, Japan and the United States. The core indicators pertain to the most recent period; most of the data in the latest (2020) Data Sheet cover the year 2018. Other indicators vary every two years, and most of them showcase recent research at the Wittgenstein Centre for Demography and Global Human Capital.

What's new in the European Demographic Data Sheet 2020?

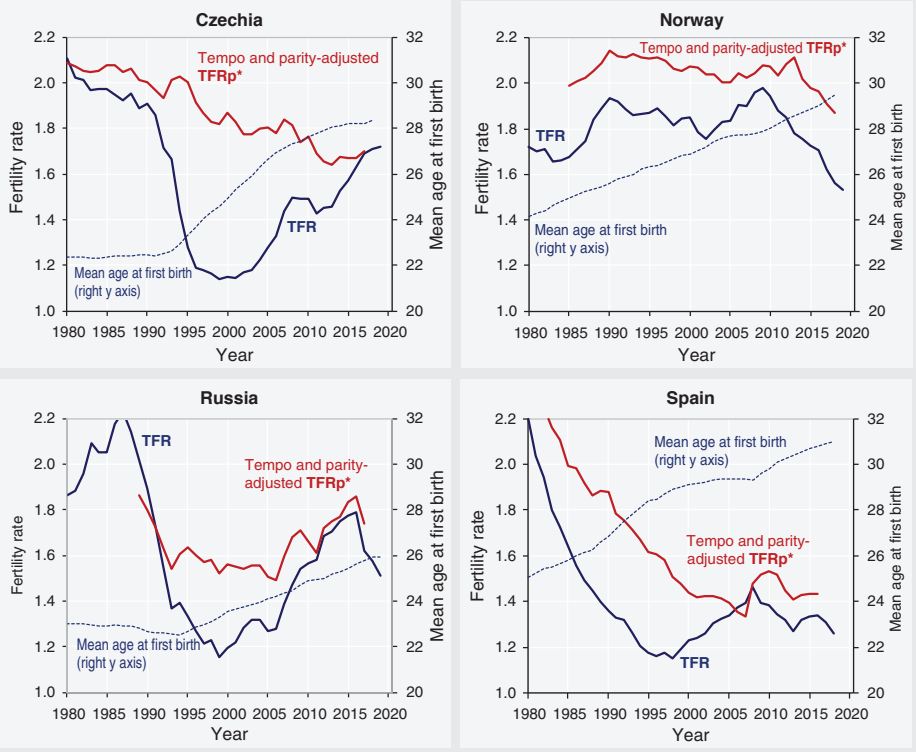
The 2020 issue puts a spotlight on health and well-being, including the indicators measuring years of life spent in good health. It also looks at the recent stagnation of life expectancy in selected countries in Europe and in the United States, the measurement of internal migration, and adjusted estimates of schooling. The online version offers users an expanded selection of maps, ranking tables and additional data. The 2022 issue of the European Demographic Data Sheet will provide initial findings on the impact of the COVID-19 pandemic on mortality and birth trends in Europe.


HOME DATA RANKINGS MAPS DEFINITIONS DATASHEET 2018 ARCHIVE
EUROPEAN DEMOGRAPHIC DATA SHEET 2020
EXPLORE, VISUALIZE AND COMPARE POPULATION INDICATORS FOR 45 EUROPEAN COUNTRIES.
DATASHEET POSTER
KEY FINDINGS
YEARS OF GOOD LIFE: A NOVEL INDICATOR TO MEASURE WELL-BEING
Years of Life = Being Alive = Life Expectancy
Capable Longevity
Years of Good Life (YoGL)
Years with positive life satisfaction
THE TEMPO EFFECT AND ADJUSTED INDICATORS OF TOTAL FERTILITY
Czechia
Norway
Russia
Spain
PERIOD TOTAL FERTILITY RATES: CONTRASTING REGIONAL TRENDS ACROSS EUROPE
Southern Europe
Western Europe
Germany, Austria, Switz.
Nordic countries
Central-Eastern Europe
South-Eastern Europe
Eastern Europe
European Union (27)
United States
STAGNATING PERIOD LIFE EXPECTANCY AT BIRTH: A CAUSE FOR CONCERN?
BEING IN SCHOOL IS NOT THE SAME AS LEARNING: ESTIMATES OF SKILLS-ADJUSTED MEAN YEARS OF SCHOOLING
THE INTENSITY AND IMPACT OF INTERNAL MIGRATION
Country Rankings
ANALYZING ECONOMIC WELL-BEING FROM A GENERATIONAL PERSPECTIVE
A NEW INDICATOR FOR MEASURING ECONOMIC WELL-BEING: INEQUALITY-ADJUSTED HEALTHY LIFETIME INCOME (IAHLI)
CONTRIBUTION OF MIGRATION AND NATURAL POPULATION CHANGE TO LONG-TERM POPULATION-GROWTH IN EUROPE 2000-2040
Relative population change between 2000 and 2019 (in %)

Highlight: Tempo- and parity-adjusted TFR

Alternative indicators to the period TFR have been developed to provide a more accurate measure of the mean number of children per woman in a calendar year, which is not affected by changes in the timing of births. The European Demographic Data Sheet features the tempo- and parity-adjusted total fertility indicator (TFRp*; Bongaarts and Sobotka 2012), which is based on age- and parity-specific fertility rates, as well as on changes in mean age at birth. When available, the TFRp* is shown for 2016. For countries lacking the required data, the Data Sheet displays the tempo-adjusted TFR (TFR-BF) proposed by Bongaarts and Feeney (1998).

Illustration: Trends in period TFR, TFRp* and mean age at first birth in Czechia, Norway, Russia and Spain



5 Wittgenstein Centre Human Capital Data Explorer

http://dataexplorer.wittgensteincentre.org

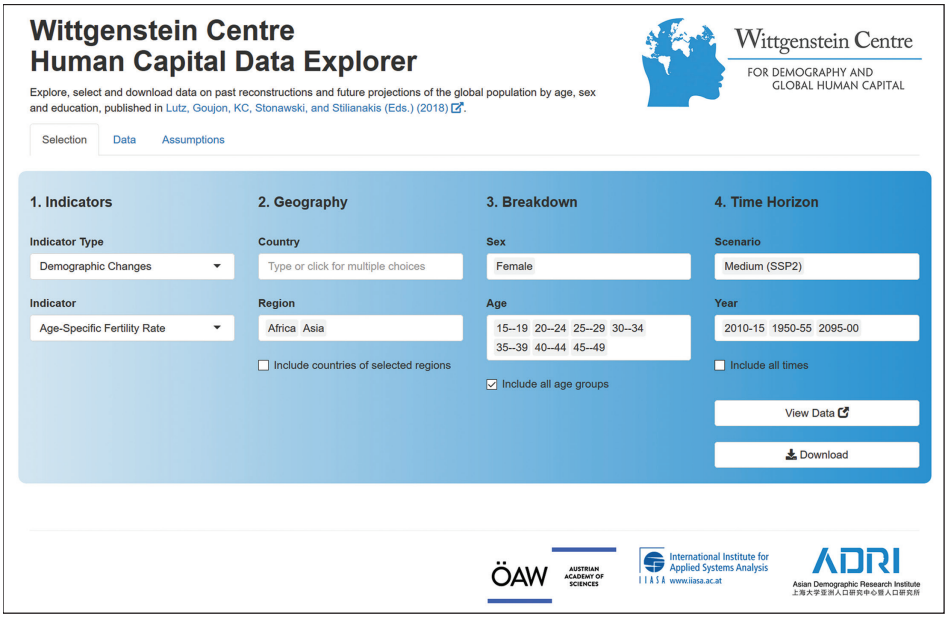
The *Wittgenstein Centre Human Capital Data Explorer* allows users to explore, select and download data on past reconstructions and future projections of the global population by age, sex and education, published in Lutz et al. (2018). This dataset is based on the work of a large team of researchers at the Wittgenstein Centre for Demography and Global Human Capital and at other institutions, and was initially developed in Lutz et al. (2014).

What's special about the Wittgenstein Centre Human Capital Data Explorer?

The Wittgenstein Centre Human Capital Data Explorer gives users easy access to a wide array of standardised data on population and human capital stocks, and demographic indicators by country, region, sex and age. The Data Explorer provides data for past periods, as well as projection scenarios and their underlying assumptions for all countries around the world. The Data Explorer also incorporates two new indicators of population ageing that go beyond the traditional conceptualisation of ageing based on fixed age boundaries: the age at which a person's remaining life expectancy is below 15 years, and the proportion of the population with a remaining life expectancy below 15 years. The Graphic Explorer allows users to visualise population pyramids and population size by education for each country and world region, and to create maps featuring the available indicators.

What data are covered in the Wittgenstein Centre Human Capital Data Explorer?

The Wittgenstein Centre Human Capital Data Explorer covers 201 countries and 29 regions for the 1950–2015 period. Data by education are shown for the population aged 15+, and are stratified by up to eight education categories. The website presents a set of five scenarios of future population and human capital trends for the projection period of 2015–2100. On top of exploring assumptions about future trends in fertility, mortality and education, the projections study the effects of several migration assumptions applied to the context of the set of Shared Socioeconomic Pathways (SSP) scenarios related to the Intergovernmental Panel on Climate Change (IPCC).

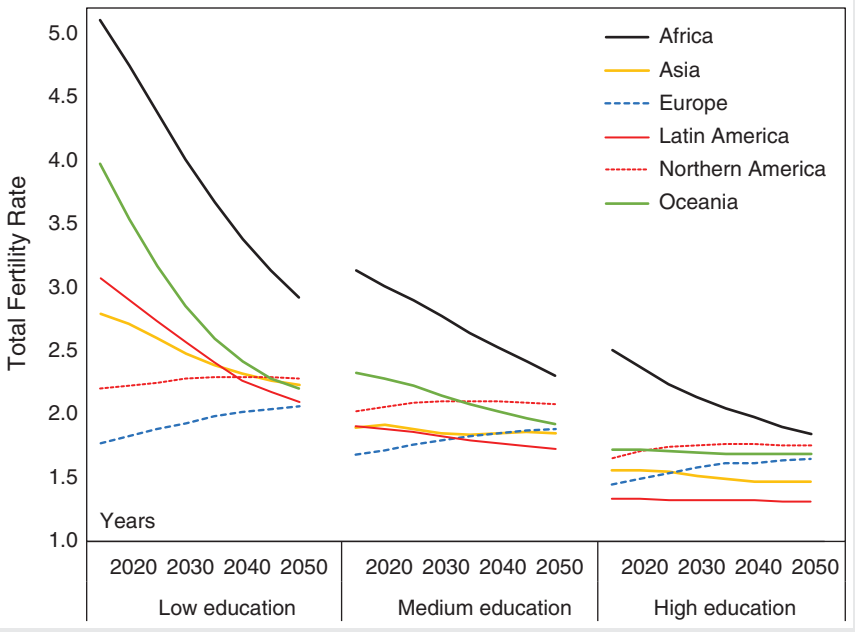


What's new in the Wittgenstein Centre Human Capital Data Explorer?

The present version (2.0), developed in 2018, benefited from the partnership with the Centre of Expertise on Population and Migration (CEPAM) at the European Commission Joint Research Centre in Italy, and with the Asian Demographic Research Institute (ADRI) in China (Lutz et al. 2018).

Highlight: Projected fertility decline by education in global regions

The figure shows the projected total fertility rate in broad world regions by level of education, based on the medium scenario for 2015–2050 developed by the Wittgenstein Centre. The *low* education category includes women with no education or primary education only; the *medium* education category covers women with lower and upper secondary education; and the *high* education category includes women with postsecondary and tertiary education.



6 Cohort Fertility and Education Database

http://www.cfe-database.org

The *Cohort Fertility and Education (CFE) database* provides high-quality data on completed cohort fertility and parity distribution by level of education (ISCED-97). The database focuses on women and men who have completed or almost completed their family building. The data come from censuses and large sample surveys and are freely accessible to all interested users.

What's special about the CFE database?

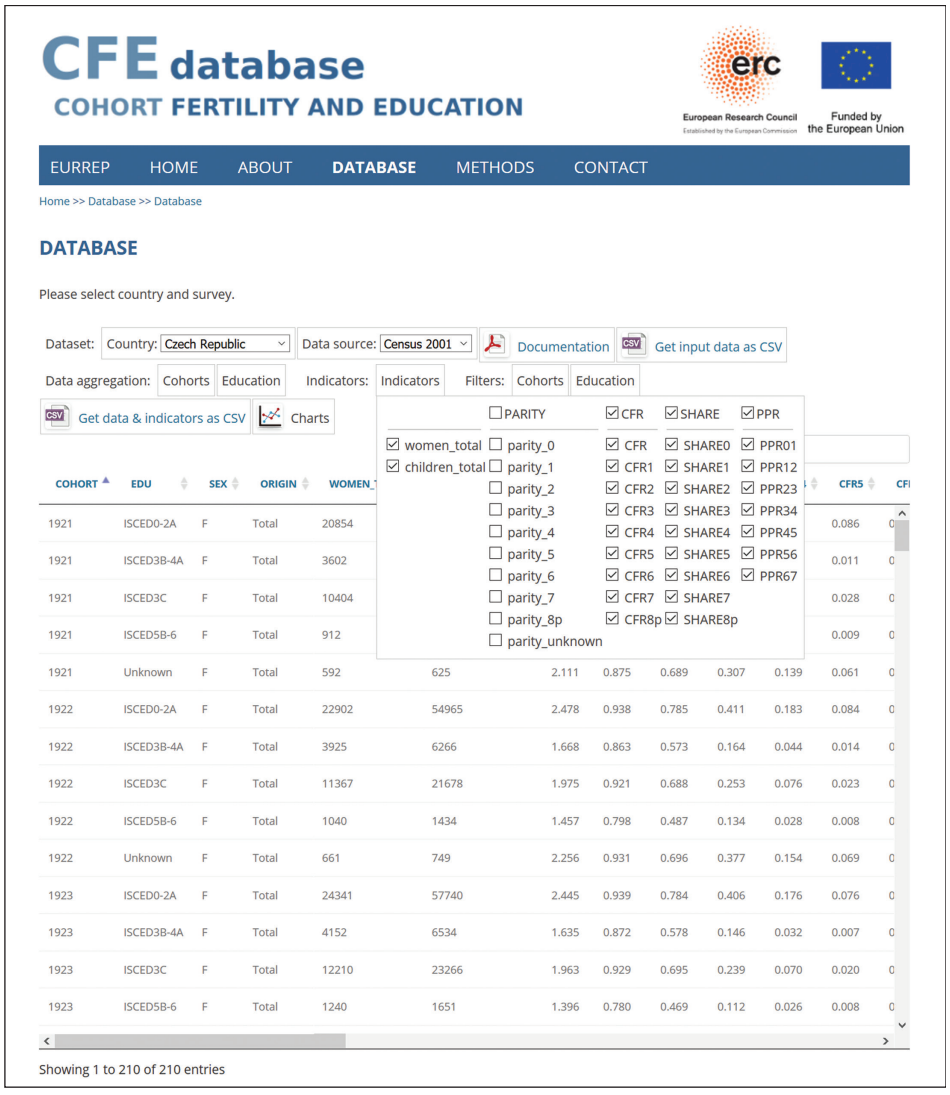
The database offers a wide range of standardised cohort fertility indicators by level of education: completed fertility rate (CFR) by birth order, share of women (and men, when available) by number of children ever born (including those who are childless), and parity progression ratios (PPR). In addition, the database includes source data on the absolute number of women (and men, when available) by birth cohort, education and number of children ever born. For some countries, data are also available by country of birth, distinguishing between two broad categories (born in the country vs. born abroad).

What data are covered in the CFE database?

Currently, the CFE database contains data from 80 censuses and surveys from 45 countries. Most of the data come from the 2001 and 2011 rounds of population censuses, with each dataset covering women (and men) aged 40 to 80 at the time of the survey or census. Regionally, the database covers both highly developed countries with relatively high levels of education and relatively low fertility (mostly in Europe), as well as selected middle-income countries, especially in Latin America. The oldest data come from the census in 1966 (South Korea), and, together with some other datasets, cover the cohorts born since the late 19th century.

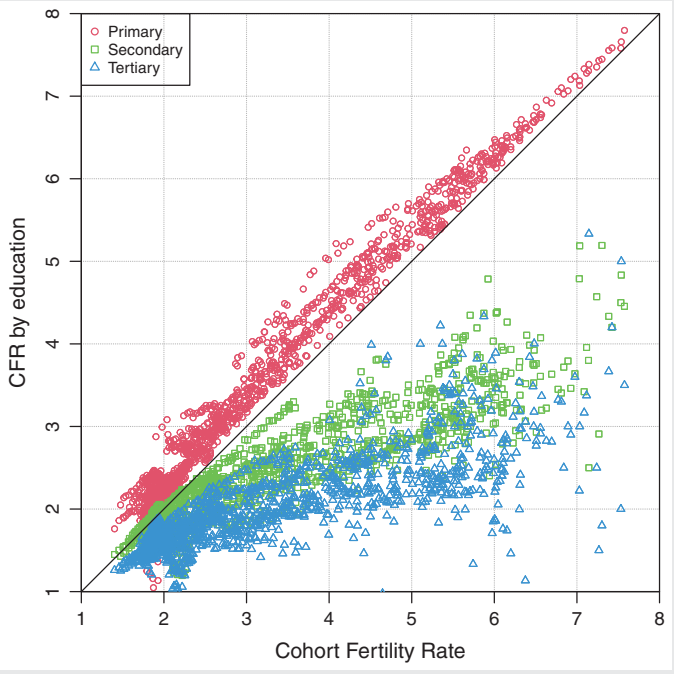
What's new in the CFE database?

In recent years, the CFE database expanded its geographical coverage and incorporated population censuses from Latin America and South-Eastern Europe, with the latter region generally being under-represented in demographic databases and in the literature. In the future, the CFE database aims to incorporate the data from the new wave of population censuses due around 2021.


CFE database
COHORT FERTILITY AND EDUCATION
European Research Council
Established by the European Commission
Funded by the European Union
EURREP HOME ABOUT DATABASE METHODS CONTACT
Home >> Database >> Database
DATABASE
Please select country and survey.
Dataset: Country: Czech Republic Data source: Census 2001 Documentation Get input data as CSV
Data aggregation: Cohorts Education Indicators: Indicators Filters: Cohorts Education
Get data & indicators as CSV Charts
PARITY CFR SHARE PPR
women_total children_total
parity_0 parity_1 parity_2 parity_3 parity_4 parity_5 parity_6 parity_7 parity_8p parity_unknown
CFR CFR1 CFR2 CFR3 CFR4 CFR5 CFR6 CFR7 CFR8p
SHARE0 SHARE1 SHARE2 SHARE3 SHARE4 SHARE5 SHARE6 SHARE7 SHARE8p
PPR01 PPR12 PPR23 PPR34 PPR45 PPR56 PPR67
COHORT EDU SEX ORIGIN WOMEN_1 CFR5
1921 ISCED0-2A F Total 20854 0.086
1921 ISCED3B-4A F Total 3602 0.011
1921 ISCED3C F Total 10404 0.028
1921 ISCED5B-6 F Total 912 0.009
1921 Unknown F Total 592 625 2.111 0.875 0.689 0.307 0.139 0.061
1922 ISCED0-2A F Total 22902 54965 2.478 0.938 0.785 0.411 0.183 0.084
1922 ISCED3B-4A F Total 3925 6266 1.668 0.863 0.573 0.164 0.044 0.014
1922 ISCED3C F Total 11367 21678 1.975 0.921 0.688 0.253 0.076 0.023
1922 ISCED5B-6 F Total 1040 1434 1.457 0.798 0.487 0.134 0.028 0.008
1922 Unknown F Total 661 749 2.256 0.931 0.696 0.377 0.154 0.069
1923 ISCED0-2A F Total 24341 57740 2.445 0.939 0.784 0.406 0.176 0.076
1923 ISCED3B-4A F Total 4152 6534 1.635 0.872 0.578 0.146 0.032 0.007
1923 ISCED3C F Total 12210 23266 1.963 0.929 0.695 0.239 0.070 0.020
1923 ISCED5B-6 F Total 1240 1651 1.396 0.780 0.469 0.112 0.026 0.008
Showing 1 to 210 of 210 entries

Highlight: Cohort fertility by education: the link between completed fertility for all women and by education group

What is the link between the education-specific fertility rates and the overall fertility levels in a country? When plotting the data for all cohorts in the censuses and surveys covered by the CFE database, the largest contrast appears at high fertility levels. In societies with very high levels of fertility either today or in the past, (including historical data on women born in the late 19th and early 20th centuries), the fertility of women with secondary and tertiary education is typically much lower than the fertility of women with primary education only. When we look at cohorts with low fertility (typically, women in the highly developed countries born since the late 1940s), the absolute differences in fertility levels diminish.



Acknowledgements

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