Faculty of Social Sciences
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DRIVERS AND FUTURE OF THE FERTILITY DECLINE IN THE 2010S:

AN ANALYSIS OF FINLAND AND OTHER NORDIC COUNTRIES

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DOCTORAL DISSERTATION

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ABSTRACT

The Nordic countries have maintained relatively high and stable cohort fertility over the past three decades, which has inspired fertility theories and cemented the idea that the generous welfare system of these countries promotes fertility. However, the narrative changed in the 2010s, as these countries' total fertility rates (TFR) declined strongly and reached all-time low levels. These declines were unexpected, remain poorly understood, and challenge the understanding of fertility patterns in the developed world. It remains unclear how this fertility decline relates to fertility timing, union patterns and the field of study – all of which are important factors in explaining fertility patterns that could generally help illuminate the mechanisms behind the decline.

This thesis analysed fertility dynamics in Finland and the other Nordic countries, focusing particularly on the decrease in period fertility in the 2010s and its consequences for completed cohort fertility by using existing methods and developing a new forecasting approach. The study used harmonized data across the Nordic countries from the Human Fertility Database (HFD) to compare age, parity, tempo, and quantum drivers of the declines, and register data from Statistics Finland both to assess the importance of changes in union patterns for the fertility decline and to identify variation in fertility declines by field of education.

Decomposition of the period fertility decline between 2010 and 2018 showed that a fall in fertility occurred at nearly all ages below 40, and that the decline in first births contributed the most to the overall decline in fertility among all Nordic countries. The fertility decline in the age group 30–39 is a departure from the long-term trend of increasing fertility, suggesting that not only fertility postponement is driving the fertility decline. Tempo adjustments to the TFR and cohort fertility forecasts both indicate that quantum change is part of the decline.

The forecasts indicated that cohort fertility is likely to decline from the long-lasting level of 2 children to around 1.8 children on average for late 1980s cohorts. Here, Finland diverges from the other Nordic countries, as its expected cohort fertility is much lower (below 1.6). In turn, Sweden and Demark are on a trajectory of weaker declines than those observed in Finland, Norway, and Iceland. The new non-parametric approach that was developed in this study assessed potential recuperation patterns and yielded the weakest declines of all methods; nevertheless, it still showed that, particularly in Finland, Norway and Iceland, cohort fertility is likely to decline even if higher age fertility were to begin to increase.

Using an incidence-based multistate Markov model, trends in age-specific transition probabilities across states of single life, cohabitation, marriage, and first birth among childless men and women showed that after 2010, first-

childbearing decreased in unions, more (cohabiting) unions were dissolved, and marriage and cohabitation formation decreased. Counterfactual simulations revealed that the decline in fertility within unions mattered more (three-quarter) than changes in union dynamics (one-quarter) for the total decline in first births. First births declined more strongly across the lower social strata, but, across all strata, decreasing first-childbearing in unions explained most of the total decline.

Trends in total fertility and first births in the 2010s across 153 fields of education showed diverging patterns in the already prevailing large differences between fields of education. Weaker declines (around -20% and less) were typically observed in fields with initially higher levels (health and teaching) and stronger declines (around -40% and more) in fields with initially lower levels (ICT, arts and humanities). Regression analyses indicated that the strength of the declines was associated with characteristics reflecting uncertainty (higher unemployment, lower income, and a lower share of work in the public sector) within the fields – together, these uncertainty measures explained one fourth of the decline in TFR and two fifths of the decline in first births.

The findings highlight the need to revise the conceptualization of the Nordic model of high and stable fertility. The decline in the 2010s was primarily accounted for by childless couples postponing or forgoing childbearing rather than by parents having smaller families. New theories increasingly highlight the role of perceived uncertainty in explaining fertility changes in the 2010s, but the findings from this study indicate that objective uncertainty also seems to be fuelling the fertility decline.

ABSTRAKT

De nordiska länderna har upprätthållit en relativt hög och stabil kohortbaserad fruktsamhet under de senaste tre decennierna. Detta har inspirerat aktuella fruktsamhetsteorier samt befäst idén att dessa länders generösa välfärdssystem främjar fruktsamheten. Narrativet förändrades emellertid under 2010-talet då den periodbaserade fruktsamheten i dessa länder sjönk kraftigt och nådde rekordlåga nivåer. Den här nedgången skedde oväntat, den är fortfarande bristfälligt förstådd, och den utmanar förståelsen av fruktsamhetsmönstren i industriländerna. Det är fortfarande oklart huruvida den sjunkande fruktsamheten är en följd av uppskjutet barnafödande till högre åldrar eller möjliga förändringar i parbildning och separationer, samt huruvida fruktsamheten sjunkit i varierande grad bland olika studieområden. Alla dessa är viktiga faktorer för att förklara fruktsamhetsmönster och skulle generellt kunna öka förståelsen för de mekanismer som ligger bakom nedgången i fruktsamheten.

Denna avhandling analyserade fruktsamhetsdynamiken i Finland och de andra nordiska länderna med ett särskilt fokus på den sjunkande periodbaserade fruktsamheten på 2010-talet och dess konsekvenser för den slutgiltiga kohortbaserade fruktsamheten med hjälp av befintliga metoder samt genom att utveckla en ny prognosmetod. Studien använde data från de nordiska länderna från HFD-databasen för att jämföra minskningen enligt demografiska faktorer (ålder, födelseordning, tidpunkt för barnafödande och faktiska mängden barnafödande). Registerdata från Statistikcentralen användes för att bedöma betydelsen av förändringar i parförhållanden för att förklara fruktsamhetsnedgången och för att identifiera variationer i intensiteten av fruktsamhetsnedgången bland olika utbildningsområden.

Uppspjälkningen av den periodbaserade fruktsamhetsnedgången mellan 2010 och 2018 visade att nedgången inträffade i nästan alla åldrar under 40 och att minskningen i förstabarnsfödslar förklarade den störta delen av den totala nedgången i alla nordiska länder. Fruktsamhetsnedgången i åldersgruppen 30–39 är en avvikning från den flera decennier långa uppåtgående trenden och tyder på att det inte är enbart uppskjutet barnafödande till högre åldrar som driver den sjunkande fruktsamheten. Både tempojusteringar av det summerade fruktsamhetstalet och prognoser för den slutgiltiga kohortbaserade fruktsamheten indikerar att även den faktiska mängden barnafödande minskar.

Enligt prognoserna kommer den kohortbaserade fruktsamheten sannolikt att sjunka från den långvariga nivån omkring 2 barn till omkring 1.8 barn i medeltal för kohorter födda i slutet av 1980-talet. Finland avviker från de andra länderna, eftersom dess förväntade kohortbaserade fruktsamhet är

mycket lägre (under 1.6). Sverige och Danmark bildar också en klass för sig med mildare nedgångar än de som förväntas i Finland, Norge och Island. Den nya icke-parametriska metoden som utvecklades i denna studie estimerade potentiella återhämtningsmönster och resulterade i de svagaste nedgångarna av alla prognosmetoder, men visade ändå att särskilt i Finland, Norge och Island kommer den kohortbaserade fruktsamheten sannolikt att sjunka även om fruktsamheten i äldre åldrar skulle stiga.

Med hjälp av en incidensbaserad flertillstånds Markovmodell visade trender i åldersspecifika övergångssannolikheter mellan tillstånden singel, samboskap, äktenskap och det första barnets födelse bland barnlösa män och kvinnor att efter år 2010 minskade det första barnets födelse bland samboende och gifta par, flera samboskap upplöstes, och färre sambo- och äktenskap ingicks. Kontrafaktiska simuleringar visade att nedgången i fruktsamheten i sambo- och äktenskap hade större betydelse (tre fjärdedelar) än förändringar i parbildning och separationer (en fjärdedel) för den totala nedgången i antalet förstabarnsfödslar. Förstabarnsfödslar minskade kraftigare i de lägre sociala skikten, men i alla sociala skikt förklarade minskade förstabarnsfödslar i sambo- och/eller äktenskap majoriteten av den totala nedgången.

Trender i den summerade fruktsamheten och i förstabarnsfödslar under 2010-talet bland 153 utbildningsområden visade divergerande mönster i de betydande skillnaderna som redan råder mellan studieområdena. Svagare nedgångar (cirka -20 % och mindre) observerades generellt inom områden med initialt högre fruktsamhetsnivåer (hälsa och undervisning) och kraftigare nedgångar (runt -40 % och mer) inom områden med initialt lägre fruktsamhetsnivåer (IKT, konst och humaniora). Regressionsanalyser visade att styrkan i nedgångarna var associerad med egenskaper som speglar osäkerhet (högre arbetslöshet, lägre inkomst och lägre andel som arbetar inom den offentliga sektorn) inom utbildningsområdena – tillsammans förklarade dessa osäkerhetsmått en fjärdedel av nedgången i det summerade fruktsamhetstalet, och två femtedelar av nedgången i förstabarnsfödslar.

Resultaten lyfter fram behovet av att uppdatera konceptualiseringen av den nordiska modellen med relativt hög och stabil kohortbaserad fruktsamhet. Nedgången under 2010-talet förklaras främst av att barnlösa par skjuter upp eller avstår familjebildning snarare än att föräldrar får färre barn. Nya teorier lyfter alltmer fram upplevd osäkerhet som en förklaring till nedgången i fruktsamheten under 2010-talet, men resultaten från denna studie indikerar att även objektiv osäkerhet verkar trigga den sjunkande fruktsamheten.

CONTENTS

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

I Hellstrand, J., Nisén, J. & Myrskylä, M. 2020. All-time low period fertility in Finland: Demographic drivers, tempo effects, and cohort implications. Population Studies, 74(3): 315–329. https://doi.org/10.1080/00324728.2020.1750677

II Hellstrand J., Nisén, J., Miranda, V., Fallesen, P., Dommermuth, L. & Myrskylä, M. 2021. Not Just Later, but Fewer: Novel Trends in Cohort Fertility in the Nordic Countries. Demography, 58(4): 1373–1399. https://doi.org/10.1215/00703370-9373618

III Hellstrand, J., Nisén, J. & Myrskylä, M. 2022. Less Partnering, Less Children, or Both? Analysis of the Drivers of First Birth Decline in Finland Since 2010. European Journal of Population, 38: 191–221. https://doi.org/10.1007/s10680-022-09605-8

IV Hellstrand, J., Nisén, J. & Myrskylä, M. Educational field, economic uncertainty, and fertility decline in Finland in 2010–2019. [Submitted]

The publications are referred to in the text by their Roman numerals.

ABBREVIATIONS

TFR	total fertility rate
EU-27	European Union – 27 countries (from 2020)
HFD	human fertility database
SDT	second demographic transition
SES	socio-economic status
ISCED	international standard classification of education
ICT	information and communication technology
TFRp1	the share expected to ever have a first birth calculated based on 5-year age-specific first birth rates (first births per number of childless women) and a lifetable approach
TFRp	TFR based on conditional age- and parity-specific fertility rates
TFR(BS)	tempo- and parity-adjusted TFR (Bongaarts and Sobotka 2012)
TFR(BF)	tempo-adjusted TFR (Bongaarts and Feeney 1998)
CFR	completed cohort fertility rate
CI	confidence interval
p	transition probability

1 INTRODUCTION

In family demographic research, Finland and the other Nordic countries have been characterized by relatively high and stable fertility (Frejka 2008; Myrskylä, Goldstein, and Cheng 2013; Zeman et al. 2018). Cohort fertility[1] has remained close to two children per woman in these countries during recent decades, while female labour market participation has also remained high (Brewster and Rindfuss 2000; Frejka, Goldscheider, and Lappegård 2018). The Nordic countries' relatively high fertility in the 1990s and 2000s cemented the idea that the generous welfare system of these countries promotes fertility. However, the narrative changed in the years after the great recession, as period fertility[2] declined strongly in the 2010s in the Nordic countries (Comolli et al. 2020). Similar declining trends in period fertility have also been observed elsewhere, but the declines in the Nordic countries, and especially in Finland, Norway and Iceland, stand out (Human Fertility Database 2022). For instance, the total fertility rate (TFR)[3] in Finland dropped from 1.87 in 2010 to all-time low levels for three consecutive years, reaching 1.35 in 2019, which is an unprecedentedly low level for any Nordic country and well below the current European average (Figure 1). The TFR in Norway has also dropped below the European average.

The Nordic countries' relatively high fertility prior to the second decade of the 21st century has often been attributed to the institutional and socio-cultural settings of these countries, which strongly promote gender equality and work-family reconciliation (Ellingsæter and Leira 2006; Rønsen and Skrede 2010). Scholars even highlight the existence of a common (high) Nordic fertility regime due to these countries' similar fertility patterns and similar work-family reconciliation policies (Andersson 2004; Neyer et al. 2006; Andersson et al. 2009). For these reasons, the Nordic countries have often been seen as forerunners in fertility behaviour, and family demographers and policy makers from around the world have been interested in the Nordic setting for decades. Furthermore, several recent fertility theories are heavily inspired by the empirical association between gender equality and fertility observed in the Nordic countries (Duvander et al. 2019). These theories postulate that, at later phases of the demographic transition, fertility will increase when men become more involved in the private sphere to ease the double burden of combining work and family typically experienced by women (Anderson and Kohler 2015; Esping-Andersen and Billari 2015; Goldscheider, Bernhardt, and Lappegård 2015). The end point to which fertility is expected

[1] Lifetime total number of children per women from a specific birth year.

[2] Number of children born within a specific period.

[3] The sum of age-specific fertility rates in a given year.

to increase according to these theories is not precisely determined, but a closing of the fertility gap (i.e., convergence between realized and desired fertility size) is expected to occur (Anderson and Kohler 2015). Although the Nordic countries, with their weak work-family conflicts and close-to-replacement cohort fertility, are typically placed towards the end of this transition (Esping-Andersen 2016), there also exists a fertility gap in these countries (Beaujouan and Berghammer 2019), indicating that a fertility increase rather than a decrease is expected there.

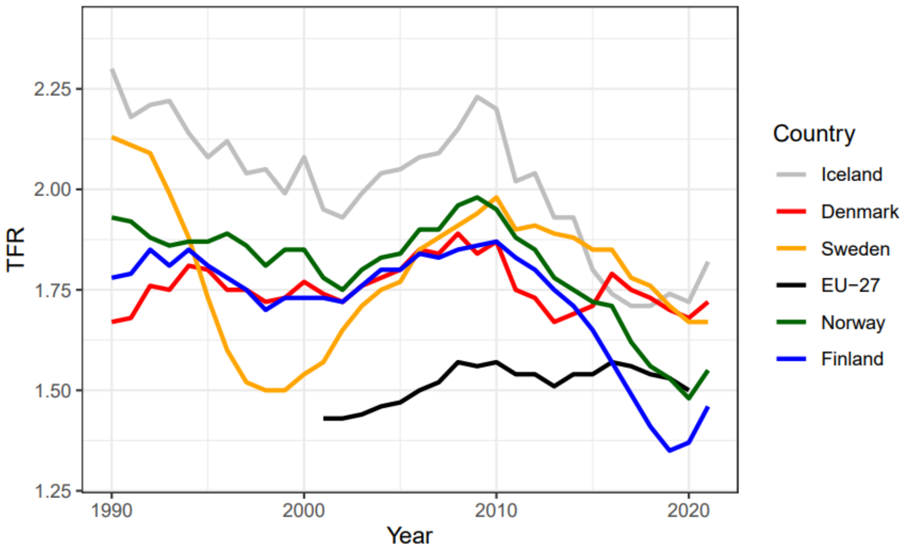

Figure 1 Total fertility rate in the Nordic countries and in EU-27 countries in 1990–2021. Source: Eurostat 2022 and Nordic statistical agencies 2022.

Decreases in period fertility do not necessarily lead to decreases in cohort fertility. Period-based measures such as the TFR can fluctuate as a result of temporary changes in fertility timing even when the total number of children remains unchanged (referred to as the "tempo effect") (Bongaarts and Feeney 1998), and period fertility tends to underestimate cohort fertility when childbearing is postponed to older ages (Myrskylä, Goldstein, and Cheng 2013). Thus, the decreasing trend in the TFR in the Nordic countries can reflect accelerated fertility postponement, lower childbearing (referred to as the "quantum effect"), or a combination of both (see the "roller coaster" shape in TFR in Sweden in Figure 1). The extent to which this decreasing trend will be reflected in future cohort fertility – the total number of children cohorts of Nordic women of childbearing age will ultimately have – remains unknown. The most recent cohort fertility forecasts for the Nordic countries predicted stable fertility (Myrskylä, Goldstein, and Cheng 2013; Schmertmann et al. 2014), but these forecasts have not utilized data after 2010, when the decline in period fertility began, and updated forecasts are therefore required. If the Nordic period fertility decline is attributed to accelerated fertility postponement, and cohorts would realize postponed births later during the life course, the implications of the period fertility decline will be less severe.

To sum up, the recent period fertility decline in the Nordic countries was largely unexpected, it has not yet been widely studied, and the mechanisms behind the decline remain poorly understood. The economic crisis of 2008 has been suggested as a potential candidate for the recent fertility decline, but the decline is insufficiently explained by recession indicators (Comolli et al. 2020), making the Nordic decline especially puzzling. Consequently, scholars have proposed rising economic uncertainty as a potential driver of the decline in Nordic fertility and that of some other European countries (Vignoli, Guetto, et al. 2020). Important questions as yet unaddressed include the demographic determinants (age and parity) driving the current fertility declines and the extent to which the decline can be attributed to tempo and quantum effects. Further, evidence from Finland suggests that the long-term increase in single living accelerated after year 2015 (Official Statistics of Finland (OSF) 2018b). Hence, changes in partnership dynamics may explain some of the period fertility decline. Adding to the Nordic fertility puzzle, most sub-population groups, including women educated to different educational levels, women residing in urban versus rural areas and women from a native versus immigrant background, have experienced pronounced and rather similar period fertility declines (Comolli et al. 2020; Ohlsson Wijk and Andersson 2022; Campisi et al. 2022). However, no studies have investigated the fertility decline by field of education. As field of education predicts future employment conditions and the work environment, differences in the strength of the fertility decline by field of education could potentially reveal some of its underlying mechanisms. More specifically, it would provide a critically important lens through which to understand the association between economic uncertainty and the recent declines. Of particularly relevance is the large variation in fertility that currently exists by field of education, which is often considered a central policy challenge in the Nordic countries (Rønsen and Skrede 2010). When fertility is declining, it is important to know whether these patterns are persisting, converging, or diverging.

The objective of this study is to contribute to a better understanding of the period fertility decline observed in the Nordic countries in the 2010s. The study uses the latest available data, including aggregated data from the Human Fertility Database and individual-level register data from Statistics Finland, and employs a variety of different existing methods and novel approaches to analyse recent fertility trends in the Nordic countries. The first aim is to assess age, parity, tempo, and quantum drivers of the period fertility decline across the Nordic countries. A further aim is to forecast cohort fertility for Nordic women currently at childbearing age using existing methods and, additionally, to assess potential recuperation patterns by developing a new forecasting approach. Third, the study aims to assess the importance of changes in union formation, union dissolution, and union-first birth for the recent fertility decline. Finally, the last aim is to relate the fertility decline to fields of education and characteristics reflecting uncertainty in these fields.

2 THE COMMON NORDIC FERTILITY REGIME

The Nordic countries share many similar characteristics in terms of their childbearing trends and family policies and thus have historically conformed to the established idea of a common Nordic fertility regime (Andersson et al. 2009). This regime, which refers specifically to a context of relatively high, stable fertility combined with high support for working mothers and consequently high female labour force participation, is widely reported in the literature (e.g. Rønsen and Skrede 2010; Jónsson 2017; Merz and Liefbroer 2018).

While the cohort fertility level of most high-income countries has continuously declined for cohorts born after the 1940s, cohort fertility in the Nordic countries has stabilized at close to replacement level for 1940–1970 cohorts (Frejka 2017; Zeman et al. 2018). Only a weak downward trend was documented from 1960s cohorts onwards, due mainly to decreasing third- and higher order childbearing rather than to increasing childlessness (however, in Finland, the weak downward trend was driven mainly by increasing childlessness) (Zeman et al. 2018; Jalovaara, Andersson, and Miettinen 2022). Scholars generally agree that the relatively high fertility levels in the Nordic countries are promoted by high levels of support for working mothers (Adserà 2004; Brewster and Rindfuss 2000). Hence, the Nordic countries are considered to provide a favourable setting for combining work and family life. Consequently, these countries have been able to sustain relatively high fertility levels despite their high female labour market participation rates (Frejka and Calot 2001; Andersson et al. 2009). For these reasons, the Nordics are typically considerer vanguards of family demographic behaviour in the Western world.

Among women born in the mid-1970s, cohort fertility ranges from 1.9 in Finland and 1.95 in Denmark and Sweden, to 2.02 in Norway and 2.24 in Iceland (Human Fertility Database 2022). By contrast, cohort fertility has fallen close to or below 1.4 in some Southern European and East Asian countries, including Spain, Italy, and Japan. The close-to-replacement cohort fertility levels seen in the Nordic countries are attributable to high proportions of two-child families (Frejka 2008; Duvander et al. 2019), relatively high third-birth progressions (Zeman et al. 2018), low proportions of one-child families (Human Fertility Database 2022), and childlessness levels close to the European average (Sobotka 2017). Iceland stands out with higher third birth rates than those of the other Nordic countries (Eurostat 2019), while Finland differs in terms of its more polarized parity distribution. Finland exhibits some of the highest levels of ultimate childlessness globally (Kreyenfeld and

Konietzka 2017), but it also contains larger proportions of families with several children than most other European countries (Human Fertility Database 2022).

One of the main demographic trends in high-income countries over recent decades has been the postponement of childbearing to older ages (Mills et al. 2011; Nathan and Pardo 2019) – a trend also witnessed in the Nordic countries. However, unlike many other countries, a striking feature in the Nordic countries is fertility recuperation at older ages, which has counterbalanced fertility postponement (Andersson et al. 2009; Lesthaeghe 2010). Hence, more recent generations of women in the Nordic countries have not had fewer children; rather, they have given birth later in life compared to earlier generations. Whereas fertility postponement is often a consequence of prolonged education and career building (Ní Bhrolcháin and Beaujouan 2012), welfare support to dual-earner parents promotes fertility recuperation (Kravdal and Rindfuss 2008; Lesthaeghe 2010). The Nordic countries indeed help both men and women participate in paid work and childrearing by offering some of the world's most generous family policies (Neyer et al. 2006; Rindfuss, Choe, and Brauner-Otto 2016).

2.1 TRENDS IN UNION PATTERNS AND CHILDBEARING WITHIN UNIONS

In the Nordic countries, family formation typically begins with cohabitation: over 90% of all first unions are cohabiting unions (Jalovaara 2012; Wiik and Dommermuth 2011). Furthermore, the proportion of over-20-year-olds living in cohabiting unions in the Nordic countries is among the highest in Europe (Corselli-Nordblad and Gereoffy 2015). While parenthood has been postponed to older ages (mean age of first motherhood is approaching 30 in the Nordic countries, see Human Fertility Database 2022), first cohabitation formation typically occurs for individuals in their early (women) or mid (men) 20s, and no delays in cohabitation formation have been observed over time (Finnäs 1995; Jalovaara 2012). This differs from most other European countries, where the first cohabitating union is formed at increasingly higher ages (Billari and Liefbroer 2010). Consequently, particularly in the Nordic countries, couples are living longer in unions without children. Nevertheless, union instability is high in the Nordic countries compared to other European nations and has been increasing across cohorts (Liefbroer and Dourleijn 2006). This means that individuals increasingly live in several co-residential unions: in Norway, for instance, the share of women who have lived in more than one union in young adulthood (by age 35) rose from less than 5 per cent in the 1927–1944 cohort to around a third of the 1965–1973 cohort (Dommermuth and Wiik 2014). Further, serial cohabitation is associated with increased risk of ultimate childlessness (Jalovaara and Fasang 2017).

When it comes to marriage and childbearing, the first child has increasingly been born to cohabiting couples. However, a study from Iceland confirmed that it is merely the order that has changed: marriage more often occurs after rather than before the first birth (Jónsson 2020). When examining differences in union patterns and union-first births across different socioeconomic groups, higher resources (such as education) promote cohabitation and particularly marriage formation (Jalovaara 2012), union stability (Jalovaara 2013), and childbearing within marriage (Jalovaara and Andersson 2018). Nonetheless, it remains unclear how union patterns and childbearing within unions have changed since 2010, how these potential changes relate to the fertility decline, and how they vary by socioeconomic status.

2.2 FAMILY POLICIES IN THE NORDIC COUNTRIES

As the Nordic countries' family policies are assumed to have contributed to a favourable setting for relatively high childbearing (Brewster and Rindfuss 2000; Adserà 2004), this section provides a brief overview of Nordic family policies. Potential policy changes in recent years are of particular interest, as they could explain some of the changes in childbearing.

The Nordic countries are social democratic welfare states where social and gender equality is an explicit policy goal (Esping-Andersen 1990). Moreover, an underlying precondition to maintain this Nordic model is that both men and women participate in the labour market. Family policies in the Nordic countries are also designed to promote gender equality rather than a higher fertility per se (Rønsen 2004). The dual earner-dual caregiver model that is promoted in the Nordic countries expects that both men and women participate not only in paid work but also in childrearing (Ellingsæter and Leira 2006; Gornick and Meyers 2009). Hence, the Nordic countries offer a long period (around one year) of paid parental leave that compensates for income loss after childbirth and guarantees that parents can return to their workplace after childrearing. Part of the parental leave can be shared freely between the parents, but a non-transferable part of the leave is earmarked for each parent. The aim of this "quota" is particularly to encourage fathers' involvement in childrearing. Furthermore, the Nordic countries guarantee access to affordable day-care for all young children regardless of the labour market status of their parents. In the Nordic countries, childcare is also considered important for the intellectual and social development of children and a right of the child (Rostgaard 2014).

Compared to other countries around the world, the Nordic countries provide parents with the most support for achieving an effective work-family balance (Thevenon 2011); however, there exists some variation between the family policies in the Nordic countries themselves. The maximum period in which parental benefit is payable varies between 39 weeks in Iceland and 69 weeks in Sweden (Nordic Social Statistical Committee (NOSOSOCO) 2017). Denmark is the only country without an part earmarked for the father (the father's quota), whereas Norway has the longest father's quota (15 weeks since 2018) (Duvander et al. 2019). The length of the father's quota tends to correlate with the actual uptake of paid parental leave by fathers, which ranges between 11% in Finland and Denmark to around 30% in Iceland and Sweden. In Sweden, Iceland and Denmark, children usually begin day-care after paid parental leave ends, but Finland and Norway provide the option to care for children at home and receive a small amount of cash-for-care compensation as an alternative to day-care (Wall and Escobedo 2012). This cash-for-care scheme is offered for a shorter period in Norway and its popularity is decreasing, while in Finland it is still heavily used and day-care coverage for 1–2-year-old children is exceptionally low (Nordic Social Statistical Committee (NOSOSOCO) 2017).

The policy environment in the 2010s was relatively stable in the Nordic countries, and there were no major shifts or cutbacks in family policies; only minor, gradual adjustments, mainly concerning changes in the father's quota, occurred. In Finland, the father's quota in its current form was first introduced in 2013, much later than in other Nordic countries, and until recently attempts to lengthen this nine-week quota had proved unsuccessful (Rostgaard 2014; Eerola et al. 2019). The Finnish family leave reform extending the length of total parental leave to more than 14 months and the father's non-transferable quota to approximately 16 weeks entered into force on 1 August 2022 (Sarkkinen and Haatainen 2021). The length of the father's quota was increased from 8 to 12 weeks in 2016 in Sweden, and has been expanded and reduced several times in Norway: from 10 to 12 weeks in 2011, from 12 to 14 weeks in 2013, from 14 to 10 weeks in 2014, and from 10 to 15 weeks in 2018 (Duvander et al. 2019). The reduction in 2014 aimed to ensure families' flexibility and freedom of choice but resulted in decreased uptake of leave by fathers (Ruud 2015). In the aftermath of the economic recession of 2009, Iceland reduced income compensation for parental leave, which resulted in a lower uptake by fathers (Sigurdardottir and Garðarsdóttir 2018; Duvander et al. 2019). When it comes to the cash-for-care schemes, the length of this payment in Norway was reduced by one year in 2012 to cover only children younger than 2 (Grødem 2014). In Sweden, the municipal scheme which allowed municipalities to choose to pay a childcare contribution to 1–3-year-olds was removed in 2016 (Nordic Social Statistical Committee (NOSOSOCO) 2017). The cash-for-care scheme still covers children up to three years of age in Finland.

The co-existence of both high female labour force participation rates and relatively high fertility levels in the Nordic countries suggests that the policy goal to promote gender equality in the public and private sphere has been successful. However, some trends are less compatible with these policy goals.

First, gender segregation in the labour market is particularly high in the Nordic countries: women tend to work in the public sector more often than men and are less likely than men to hold managerial positions (Mandel and Semyonov 2006). Further, fertility is much higher among women educated to work in female-dominated occupations in the public sector, such as health and teaching, than among women within less gender-segregated or male-dominated fields (Lappegård and Rønsen 2005; Hoem, Neyer, and Andersson 2006b). These fertility differences between fields of education have been consistent over time since the 1950s cohort (Rønsen and Skrede 2010). This differs from patterns of completed fertility at different levels of education, where the differences have been reduced (or have even disappeared) (Jalovaara et al. 2019). To sum up, behind previously relatively high and stable fertility levels prevail a pattern of gender-segregation according to field of educational and considerable fertility variation between these fields. This indicates that the policy goal of reconciling work and family has not been realized to the same extent in all fields, although selection of certain fields of education based on family preferences may also play a role in the existing fertility variation.

2.3 FINLAND AS AN OUTLIER

Finland is often situated within the established idea of a Nordic fertility regime, as it shares many similar characteristics in childbearing trends and family policies with other Nordic countries (Andersson et al. 2009). However, Finland can be seen as an outlier in some respects due to its polarized parity distribution, the prevailing differences in completed fertility by level of education, and its strong preference for the home-care allowance scheme.

Over many decades, Finland has exhibited a higher level of ultimate childlessness than that of other Nordic countries. Indeed, Finland's level of ultimate childlessness ranks among the highest in Europe (Kreyenfeld and Konietzka 2017). While ultimate childlessness plateaued at 12–15% for women born in the 1960s and early 1970s in other Nordic countries, ultimate childlessness rose to above 20 per cent for women born in the early 1970s in Finland (Jalovaara et al. 2019). Ultimate childlessness seldom results from an early decision not to have children; rather, it is usually a consequence of postponing childbearing until it becomes too late, which is also the case in Finland (Miettinen 2010). Ultimate childlessness strongly relates to the absence of stable union histories: most Finns without their own children have either never lived in co-residential partnerships or have fragmented partnership histories (Jalovaara and Fasang 2017). Furthermore, the likelihood of remaining childless decreases with union length (Saarela and Skirbekk 2019).

Moreover, completed fertility among mothers has increased since the 1950s cohort and remained stable since the 1960s cohort in Finland (Jalovaara, Andersson, and Miettinen 2022). This differs from the other Nordic countries, where higher order childbearing has declined (Zeman et al. 2018). Hence, the parity distribution has become even more polarized over time in Finland. Fertility patterns by education also differ in Finland compared to the other Nordic countries. In the past, a negative education gradient in fertility prevailed in the Nordic countries: the lowest educated women exhibited the highest completed fertility and the highest educated the lowest completed fertility, but this gradient disappeared by the early 1970s cohort in all Nordic countries but Finland (Jalovaara et al. 2019). By contrast, in Finland, the gradient has remained more stable over time, with a mean number of children above two for the least educated, and a mean number of below 1.8 children for the highest educated. Further, whereas highly educated women more often have precisely two children, the least educated display high rates of both childlessness and large families (Jalovaara, Andersson, and Miettinen 2022).

Moreover, compared to other Nordic countries, Finland differs in the care provided for small children. The home care allowance scheme has strong roots in Finland (Erlandsson 2017), and most mothers make at least some use of the payment (Haataja and Juutilainen 2014). While day-care coverage for 1–2-year-olds has steadily increased to 70–90% in recent decades in other Nordic countries, day-care coverage has only slowly increased in Finland and remains below 50% (Nordic Social Statistical Committee (NOSOSOCO) 2017). There have been several attempts to shorten the home care allowance payment in Finland, but none have been successful (Salmi and Lammi-Taskula 2013; Heinonen and Saarikallio-Torp 2018). Hence, Finland can be viewed as less advanced in gender equality in this respect, as Finnish mothers tend to take extensive long leave from work to care for their children.

3 THEORETICAL FRAMEWORK

3.1 THEORY OF DEMOGRAPHIC MEASUREMENT: PERIOD, COHORT, TEMPO, AND QUANTUM CHANGES IN FERTILITY

Understanding fertility dynamics in an era of fertility postponement requires combining the theory of demographic measurement with the theoretical frameworks on the individual and institutional circumstances shaping childbearing decision-making. Measurement theory becomes critically important once it is acknowledged that trends in period-based measures like the TFR do not necessarily translate into trends in cohort-based fertility measures (Ryder 1964; Bongaarts and Feeney 1998). In the Nordic countries, most of the previously observed variation in period fertility over the past three decades has been attributed to shifts in fertility timing, given that completed cohort fertility has remained nearly constant for cohorts born since the 1940s (Andersson et al. 2009). A key example is Sweden's "roller-coaster fertility" (Hoem 2005), where the TFR exhibited major fluctuations around 1990: the TFR rose from 1.61 in 1983 to 2.14 in 1990 and then fell to an all-time low of 1.51 in 1999 before recovering again. These fluctuations nonetheless had no implications for cohort fertility. It therefore remains unclear how the recent period fertility declines in the 2010s will affect the final numbers of children Nordic women currently of childbearing age will ultimately have. It is important to disentangle tempo and quantum declines in fertility because a temporary drop in fertility due to postponement would be much less severe for the population structure. From an individual perspective, such changes are also important to disentangle in order to identify and close the gap between intended and realized fertility (Beaujouan and Berghammer 2019).

The TFR estimates what the average total number of children born to each woman would be for a fictive group of women if they experienced the age-specific fertility rates obtained for one calendar year over their entire reproductive lives; therefore, it is not necessarily indicative of the number of children any real female cohort will eventually have. Period-based measures are sensitive to the timing of childbirth (Bongaarts and Feeney 1998) and tend to underestimate the actual fertility experience when childbearing is being postponed (Myrskylä, Goldstein, and Cheng 2013). Thus, a decrease in the TFR can be driven by both delayed childbearing (tempo change) and less childbearing (quantum change), as quantum and tempo changes in fertility often occur simultaneously (Bongaarts and Sobotka 2012). A cohort perspective is free from the tempo distortions influencing the TFR, and a decrease in cohort fertility purely reflects less childbearing. Cohort fertility trends are therefore better suited than short-term period fertility trends to explaining long-term changes in society. Cohort-based fertility measures can, however, only be obtained after a cohort of women has lived to the end of their reproductive years. However, this challenge can be partly overcome with forecasting.

Figure 2 illustrates the relationship between completed cohort fertility and period total fertility in a Lexis diagram covering the period 1982–2019 and ages 15–49. The dark green diagonal line represents the completed cohort fertility for the cohort born in 1972, who began their reproductive years in 1987 and approached the end of them towards the end of the 2010s. Comparing this level with the TFR level in the period when the cohort in question was at the prime of its childbearing age (around age 30 in 2002, as represented by the light green diagonal line) yields an estimate of the postponement effect in that period. Correspondingly, forecasting the completed cohort fertility level for women currently around 30 yields some indication of the postponement effect in the TFR in recent years. Another way to estimate the postponement effect is to calculate tempo-adjusted measures for the TFR that account for the increase in the mean age of childbearing (Bongaarts and Feeney 1998; Bongaarts and Sobotka 2012). The difference between this measure and the TFR yields the tempo effect, and an increasing gap between these two indicates that changes in fertility timing increasingly distort the TFR.

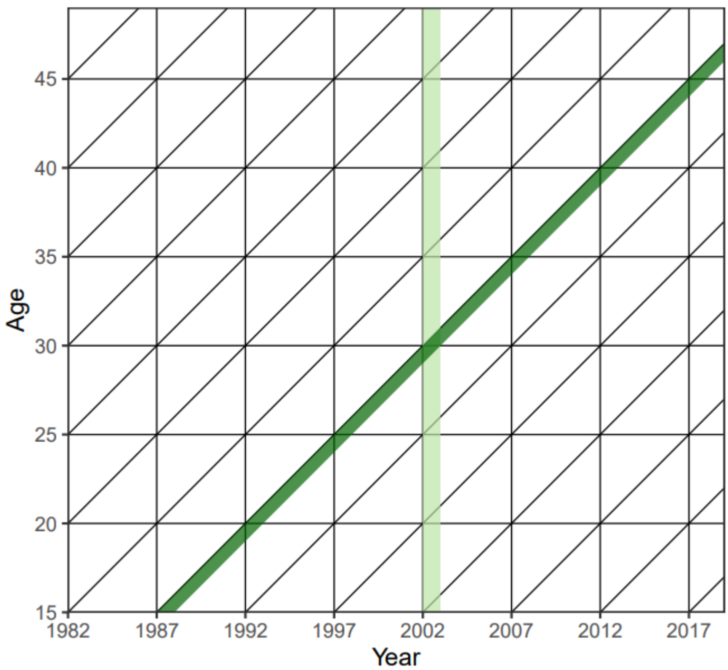

Figure 2 Lexis diagram covering the period 1982–2019 and ages 15–49 and illustrating, based on age-specific fertility rates, the total fertility rate in 2002 (light green) and the completed cohort fertility level for the cohort born in 1972 (dark green).

3.2 DEMOGRAPHIC THEORIES EXPLAINING FERTILITY CHANGE

Family demographic patterns have undergone substantial changes in high-income countries over the past decades. Since the 1960s, fertility and marriage have decreased, divorce and non-marital cohabitation have risen, and childbearing in cohabitation has become widespread (Lesthaeghe 2010). Further, although much of the variation in total fertility across countries depends on variation in second and higher-order births (Frejka 2008; Zeman et al. 2018), childlessness is becoming increasingly important in shaping fertility patterns in high-income countries (Miettinen et al. 2015; Kreyenfeld and Konietzka 2017). The early fertility declines that began in the 1960s were fuelled by increased availability of efficient contraception (Goldin 2006), but declines thereafter have typically been attributed to higher levels of socioeconomic development, changes in gender roles, and shifts in attitudes and norms. More recently, scholars have emphasized the importance of broader perceived uncertainty in fertility (and marriage) declines.

3.2.1 GENDER EQUALITY THEORIES

The long-term fertility decline associated with the demographic transition was initially linked to socioeconomic development (Lee 2003; Bryant 2007). At earlier stages of the demographic transition, fertility rates decreased when societies reached more advanced levels of socioeconomic development. However, this negative correlation weakened or even turned positive in the most developed societies in the 2000s (Myrskylä, Kohler, and Billari 2009; Fox, Klüsener, and Myrskylä 2018). This change appeared to be driven by improvements in gender equality and fertility increases at older ages (Myrskylä, Goldstein, and Cheng 2012). Anderson and Kohler (2015) compared the timing of the socioeconomic development across countries and noted that countries that developed earlier enjoyed higher levels of gender equality. Scholars began to formulate the idea that improvements in gender equality were essential for hindering fertility declines to very low levels (McDonald 2000, 2013). The negative relationship between female employment and fertility became positive in the late twentieth century (Ahn and Mira 2002), and this fuelled the family demographic theories predicting a U-shaped trend in fertility levels over time (Myrskylä, Billari, and Kohler 2011; Esping-Andersen and Billari 2015).

Following much of the reasoning of McDonald (2013) and the empirical trends observed particularly in the Nordic countries, recent theories state that improvements in gender equality raise fertility rates and strengthen the family in terms of increased union formation and decreased separation or divorce (Goldscheider, Bernhardt, and Lappegård 2015). In particular, these theories emphasize that gender equality in the family should catch up with the gender equality emerging in the educational system and the labour market in order for fertility to recover. When women enter the labour market while still bearing the main responsibility for housework and childcare, their work-family conflicts are expected to increase and fertility to decrease. This double burden among women can be reduced if men assume greater responsibility for unpaid work at home, and thereby men's involvement in the family will increase fertility. Goldscheider, Bernhardt, and Lappegård (2015) discuss a two-stage gender revolution: first women enter the labour force, and then men become more involved in the family. The first stage of the gender revolution has already emerged in most developed countries and has placed stress on family relationships and depressed fertility, but the second stage is currently emerging at varying speed in many countries, and it is expected to strengthen the family and promote fertility. Similarly, Esping-Andersen, and Billari (2015) predict a return to higher fertility once gender egalitarian norms achieve normative dominance in society.

Nonetheless, the decline in period fertility witnessed in the 2010s appears to challenge theories linking improvements in gender equality with increases in fertility. Prior to the recent fertility decline, the U-shaped prediction linking gender equality and fertility was also criticized for its focus on cross-sectional evidence of the link between gender equality and fertility, since longitudinal analyses do not provide strong support for this connection (Kolk 2019). Improvements in gender equality may have helped prevent cohort fertility from falling to very low levels, but there is no evidence that it has increased cohort fertility (Frejka, Goldscheider, and Lappegård 2018). One potential explanation for the lack of a strong positive association could be that improvements in gender equality have changed men's incentives for having children in ways that are not yet understood, and some of these forces may be negative. Furthermore, these theories remain predictions, and the final outcome is yet to be observed, as no country has reached full gender equality in either the public sphere or the family. This means that the relatively high fertility earlier seen in the Nordic countries could, in fact, be the result of "gender equality light" rather than gender equality (Rønsen and Skrede 2006). Even though Nordic women have long been active in the labour market, part-time work to facilitate child rearing is common among women (although less so in Finland), and even in the Nordic countries women still preform more unpaid work than their male partners (Hook 2006; Prince Cooke and Baxter 2010). Nevertheless, there have been no setbacks in the development in gender equality or major changes in family policies in the recent decade that could, according to the theories, cause fertility to decline. The fertility decline therefore calls for alternative explanations.

3.2.2 THE SECOND DEMOGRAPHIC TRANSITION (SDT) THEORY

Another central theory that aims to explain changes in family demographic patterns over recent decades is the second demographic transition (SDT) theory, which is fundamentally different from gender equality theories. While gender equality theories expect a reversal towards “more family”, the SDT predicts a continuously weakening role for the family and sustained low fertility levels (Lesthaeghe 2010). According to the SDT, fertility declines are driven by shifts in attitudes and norms towards greater individual autonomy and self-actualization (Surkyn and Lesthaeghe 2004). The central idea is that institutional control and authority diminish and are replaced by greater individual autonomy in decision-making, and once individuals achieve material well-being, the emergence of “higher-order needs” drives fertility intentions (Mills et al. 2011). Having children becomes a more conscious choice taken to achieve greater personal self-fulfilment (Van De Kaa 1987), and childbearing may be postponed or foregone if it is considered to compete with other life goals (Liefbroer 2005). Changes in values are expected to both increase childlessness and to decrease higher order births, as the latter may result in additional obstacles to self-fulfilment (Lesthaeghe 2014). Further, the theory proposes that the importance of marriage will decrease, and greater emphasis will be placed on the quality of relationships, consequently leading to the postponement of commitments and increasing union dissolution.

When the SDT theory was first formulated, it was assumed that shifts in demographic behaviours would first be adopted by the more highly educated with more advanced post-materialist values, after which they would eventually spread to the rest of society (Lesthaeghe and Surkyn 1988). Nonetheless, a challenging feature of this theory has been the fact that the Nordic countries have simultaneously exhibited the most individualistic values and among the highest fertility rates of all developed countries (Surkyn and Lesthaeghe 2004). Further, many SDT features – e.g., ultimate childlessness, childbearing in cohabitation, union dissolution and never partnering – are currently more strongly prevalent in lower SES groups in the Nordic countries (Perelli-Harris et al. 2010; Jalovaara and Fasang 2017; Jalovaara et al. 2019). Some features were initially more prevalent among the higher educated: ultimate childlessness was highest among the higher educated among 1940s and 1950s cohorts, but this positive gradient became negative for 1960s/1970s cohorts (Jalovaara et al. 2019). Similarly, divorce was initially most prevalent among the higher educated, but this positive gradient had disappeared by the late 1980s, after which a negative gradient emerged over time (Härkönen and Dronkers 2006). For other features, e.g., childbearing in cohabitation, the educational gradient has always been negative (Schnor and Jalovaara 2019). Nevertheless, it is not known how union patterns and union-first births changed across educational groups in the 2010s.

3.2.3 ECONOMIC CONSTRAINTS AND PERCEIVED UNCERTAINTY

Further, economic constraints and uncertainty also represent important factors in explaining trends in family demographic patterns (Kreyenfeld 2010; Kreyenfeld, Andersson, and Pailhé 2012). According to microeconomic theories, greater socioeconomic resources among couples promote childbearing, given the direct costs associated with children, as long as such costs are not counterbalanced by higher opportunity costs (Becker 1993). Moreover, empirical evidence shows that fertility patterns tend to follow business cycles: childbearing is often postponed in economically uncertain times and favoured during periods of economic growth (Sobotka, Skirbekk, and Philipov 2011). Of all parities, economic uncertainties negatively affect the first birth in particular (Blossfeld and Hofmeister 2006). Additionally, economic uncertainty may also negatively influence fertility through its negative impact on the initial steps of family formation (union formation and union stability) (Mills and Blossfeld 2003).

The recent fertility decline was initially linked to the economic crisis of 2008, but the fact that the decline continued and even accelerated after macroeconomic recovery emphasizes the need for a broader framework of perceived uncertainty to explain fertility patterns (Comolli et al. 2020). It has been hypothesized that people's feeling of uncertainty increased following the Great Recession and during the 2010s due to globalization dynamics, new technologies, and media channels, thereby increasing the difficulty of planning for the future (Vignoli, Guetto, et al. 2020). Increased housing uncertainty as reflected in rising dwelling rents (Official Statistics of Finland (OSF) 2021b) and the drop in home ownership (Official Statistics of Finland (OSF) 2018a) in the 2010s may add to this broader perceived uncertainty and its influence on childbearing (Tocchioni et al. 2021). Expectations and perceptions of the future that do not necessarily reflect a person's own economic situation or current circumstances are considered to play an increasingly important role in shaping fertility decisions (Vignoli, Bazzani, et al. 2020). In the Narrative Framework, these perceptions arise from individuals' past experiences and shared narratives from peers, social media, or others, and people act according to or despite uncertainty in their own lives based on their narratives of the future (Vignoli, Bazzani, et al. 2020). Perceived uncertainty is also considered to influence marriage intentions, but not necessarily the intention to cohabit, because of its looser commitment (Guetto, Vignoli, and Bazzani 2020).

Following this line of research, analysing the decline in fertility by field of education provides an opportunity to understand the role of economic uncertainty as a driver of the decline, as field of education predicts future employment conditions and income security (Kogan and Müller 2003; Salas-Velasco 2007; Begall and Mills 2012). Some fields, such as general education, fine arts and humanities, and general social sciences, do not lead to any particular occupation, and individuals educated in these fields may face difficulties becoming established in the labour market and thus experience higher unemployment risk (Hoem, Neyer, and Andersson 2006b). Other fields, such as those pre-dominantly leading to jobs in the public sector, could be considered more stable, as the public sector is less subject to fluctuations in the economy than is employment in the private sector (e.g. Kopelman and Rosen 2016). A stronger decline in more objectively uncertain fields would indicate that objective uncertainty is fuelling the fertility decline, whereas similar declines across all fields would be in line with the Narrative Framework, which highlights perceived uncertainty irrespective of a person's actual circumstances as a driver of fertility change.

4 SUMMARY OF THE PRIOR LITERATURE

The Nordic countries maintained relatively high cohort fertility compared to many other developed countries for several decades – a feature that cemented the idea that the generous welfare system of these countries promotes fertility (Ellingsæter and Leira 2006; Andersson et al. 2009). Despite a shift in fertility to older ages also in the Nordic countries, cohort fertility remained stable because Nordic women succeeded remarkable well in catching up on postponed births later during the life course. It is particularly worthy of note that the theories predicting increases in fertility with improvements in gender equality (Esping-Andersen and Billari 2015; Goldscheider, Bernhardt, and Lappegård 2015) are heavily inspired by the patterns seen in the Nordic countries. However, period total fertility rates declined strongly and unexpectedly in the Nordic countries in the 2010s, which challenges these theories, as there were no major changes in social policies in that decade.

Other theoretical explanations that aim to explain fertility change also seem insufficient – for instance, the SDT predicts sustained sub-replacement fertility as a consequence of changes in new values first observed among the highly educated, but the Nordic countries have long exhibited individualistic values (Surkyn and Lesthaeghe 2004) and witnessed pronounced fertility declines only after 2010. Instead, the Nordics are facing growing social inequality in family formation: ultimate childlessness is increasing fast among the least educated individuals (Jalovaara et al. 2019). Whereas, in the past, higher educated women and lower educated men exhibited the highest levels of childlessness, female patterns are changing and becoming more similar to those of men. Today, both the highest educated men and women are the most likely to have children, and the lower educated are left behind. Trends in union patterns and union-first births by educational group could help illuminate the relevance of the SDT as an explanation for the recent fertility decline as well as reveal economic obstacles to family formation. Analyses by gender provide additional information on the unfolding of gendered fertility patterns during the fertility decline. A previous study has shown that in a sample of Finnish couples formed between 1985 and 2009, 53% of these couple years was accounted for by homogamous couples (where secondary education was the most common pairing), 31% by hypogamous couples (the female being more highly educated), and 15% by hypergamous couples (the male being more highly educated) (Nitsche, Trimarchi, and Jalovaara 2022). Hence, inequalities are likely to accumulate in couples. Trends in union patterns and union-first births are explored for both men and women and their contributions to the first birth decline estimated using state-of-the-art statistical methods in sub-study III.

Only a limited number of studies have investigated the Nordic decline that occurred in the 2010s, and a clear understanding is still lacking. Pronounced declines have been observed across most sub-population groups (Lappegård and Dommermuth 2015; Ohlsson Wijk and Andersson 2022; Campisi et al. 2022), and the mechanisms behind the decline are therefore unclear. Comolli et al. (2020) attempted to link the decline to the Great Recession in 2008 but noted that recession indicators were unable to sufficiently explain it. Consequently, scholars then suggested increased perceived uncertainty as a central driver of the decline (Vignoli, Bazzani, et al. 2020). However, one prominent feature is that first births have declined more strongly among the least educated and/or among those with a weaker labour market attachment (Comolli et al. 2020; Ohlsson Wijk and Andersson 2022), which indicates that objective uncertainty is fuelling the decline. These trends are of particular relevance because concerns have been raised about not only increases in childlessness among the least educated but also the current pronounced variation in fertility between fields of education, which differ greatly in terms of employment stability (Rønsen and Skrede 2010). Women educated in health and teaching exhibit the highest fertility and the lowest levels of childlessness (Begall and Mills 2012; Michelmore and Musick 2014; Oppermann 2017), while women educated in arts and humanities display low fertility and high levels of childlessness (Hoem, Neyer, and Andersson 2006a, 2006b). These differences are often attributed not only to the better working conditions and a more supportive work-family environment enjoyed by the former group (Hoem, Neyer, and Andersson 2006b) but also to differences in family orientation between these fields (Van Bavel 2010). Sub-study IV calculates fertility estimates for a large number of educational fields using register data, monitors the fertility variation in times of changing overall fertility levels, and explores the association between the strength of the fertility declines and economic uncertainty within the fields.

Another yet unaddressed and highly important issue is whether the recent Nordic fertility decline is a result of accelerated fertility postponement, lower actual fertility, or both. Sub-study II compares tempo and quantum changes in the Nordic countries in the 2010s. Further, the potential link between the acceleration in the increase in single living in Finland (Official Statistics of Finland (OSF) 2018b) in the recent decade and the fertility decline has not yet been explored. This link is explored in sub-study III. Forecasts addressing future cohort fertility patterns in the Nordic countries used data before 2010 (before the decline began) and are therefore outdated (Myrskylä, Goldstein, and Cheng 2012). Updated forecasts for the Nordic countries are produced in sub-study II. Furthermore, even the best preforming forecasting methods struggle to accurately predict cohort fertility in times of abrupt trend changes (Bohk-Ewald, Li, and Myrskylä 2018), which highlights the need for new forecasting approaches in the current circumstances. A new non-parametric approach to forecasting cohort fertility without strict modelling assumptions is developed in sub-study I and further applied in sub study II.

5 AIMS OF THE STUDY

The aim of this study is to analyse fertility dynamics in Finland and other Nordic countries, as these countries are undergoing rapid changes in childbearing behaviour and are currently experiencing unprecedentedly low levels of period fertility. In more detail, focusing on the 2010s, the aims of this study are: (1) to study the trends in age- and parity-specific fertility and to estimate the tempo and quantum changes of the fertility decline in all Nordic countries; (2) to forecast completed cohort fertility for Nordic women aged 30 and older and assess possible recuperation patterns in fertility by developing a new nonparametric cohort fertility forecasting approach; (3) to study the trends in union first-birth dynamics over time in Finland, assess the extent to which the decline in first births in Finland is driven by changes in union patterns, and explore how these changes vary by socioeconomic status, and (4) to investigate how the decline in total fertility and first births in 2010–2019 in Finland varies by educational field and whether the strength of the decline is related to characteristics reflecting uncertainty in these fields. The specific research questions are:

1. What are the age- and parity drivers of the Nordic fertility declines? To what extent is the decline driven by fertility postponement? (I, II)
2. Are Nordic women born after the early 1970s likely to have fewer children than earlier cohorts and, if so, how many fewer? Could strong recuperation patterns keep cohort completed fertility stable? (I, II)
3. To what extent is the decline in first births in Finland related to changes in union patterns? Are there differences by socioeconomic status? (III)
4. Does the strength of the fertility decline vary across educational fields? Can characteristics of the field reflecting economic uncertainty explain the strength of the fertility decline? (IV)

Completed cohort fertility is one of the main goals of interest in sub-study I and II. Sub-study I develops a novel nonparametric approach to forecasting completed fertility that allows for abrupt trend changes in fertility, as such changes are a challenge for most existing cohort fertility forecasting methods. This approach was developed to assess whether the strong recuperation patterns seen in the past could prevent Finnish completed cohort fertility from falling strongly, or, in other words, whether it is likely that women who have postponed childbearing can catch up on postponed births to such extent that cohort fertility will remain stable. Sub-study II uses this novel approach, together with existing forecasting methods, to predict completed cohort fertility across the Nordic countries. These forecasts utilize data covering the decline in the 2010s and update outdated forecasts from previous studies. Additionally, the first two sub-studies focus on the age and parity drivers of the recent period fertility decline and on tempo effects. Moreover, whereas sub-study I focuses on Finland, sub-study II extends the analyses to all Nordic countries. Sub-studies I and II both aim to investigate whether the recent decline in period fertility is attributable to tempo or quantum changes – a topic that has not yet been studied in detail.

Partnership dynamics and the progression to the first birth among the childless are the main areas of interest in sub-study III. The study aims to investigate the role of (potential) changes in partnership patterns (the transition to cohabitation and marriage, and union dissolution) in explaining decreasing first-birth rates among both men and women. First births could be decreasing because the number of couples at risk to have a first birth is decreasing, because couples increasingly postpone or forgo childbearing, or because of a combination of these factors. Trends by socioeconomic status (SES) can illuminate such changes because different SES groups may change their behaviour for different reasons (Kravdal and Rindfuss 2008; Lesthaeghe 2010). This study responds to the trends observed in (increased) single living in Finland, adds to the discussion on the theoretical explanations of the fertility decline, and explores the developments in social inequality in family formation among both men and women.

Sub-study IV focuses on the change in total fertility and first births in 2010–2019 by a large number of educational fields. The change is analysed in a regression framework, and characteristics of the fields (i.e., unemployment, income, and public-sector employment) serve as explanatory variables. The study is the first to produce fertility estimates by field of education in Finland, and it adds to the discussion on uncertainty and fertility change.

6 DATA AND METHODS

6.1 DATA

This dissertation is based on both aggregated and individual-level data. Sub-studies I and II use aggregated data from the Human Fertility Database (HFD). The HFD is a freely available database containing high-quality period and cohort fertility data from many developed countries. The database is maintained through collaboration between the Max Planck Institute for Demographic Research and the Vienna Institute of Demography. The HFD receives data from data providers (i.e., country experts, statistical offices, and research institutions) and/or processes and updates data with some time delay. To complete the time-series with the most up-to-date data for Finland at the time of analysis, preliminary data for the years 2016–2017 were provided through personal communication with the HFD for sub-study I. Similarly, sub-study II complemented the HFD with the most recent data (until 2018) from each country's national statistical agency on births and the female population for the Nordic region. These data were used to calculate fertility rates to match the format of the HFD. Sub-studies III and IV use Finnish national longitudinal population register data compiled at Statistics Finland (permission no. TK-52-1119-17). Different register sources that include information on births, housing, education, and other individual-level characteristics are linked together through personal identification numbers. The register data offer full coverage of the total population of Finland.

Sub-studies I and II use different types of fertility rates from the HFD. For exploring period fertility trends and estimating tempo-effects, they use fertility rates by calendar year, age, and birth order. For forecasting cohort completed fertility, they use incidence rates that indicate the (age-specific) number of children born per woman in a certain cohort regardless of parity. These cohort-based rates are utilized for all countries in the HFD with data available from the 1900 birth cohort onwards to build the forecasting model. Further, conditional fertility rates that control for both age and parity (e.g., the number of second births by all women with exactly one child) are used for age and parity decompositions. Sub-study II additionally uses another type of conditional rates for the tempo-adjustments: births of order i related to women at parity lower than i. For period-based rates, the age of the mother was recorded at the time of the birth, whereas, for cohort-based rates, the age of the mother was recorded at the end of the year.

The sample used in sub-study III comprises all childless men and women aged 15–45 who permanently resided in Finland at the end of each year in 2000–2018. These individuals were followed until the birth of their first biological child or until their 45th birthday, whichever occurred first. In sum, the study population consists of 2 532 375 individuals and 23 847 070 person-years. All first births that were incorrectly linked to two biological mothers/fathers (less than 0.06% of all first births), and all individuals linked to such a first birth (n=388) were excluded from the study, as the true biological parent remained unknown for these links. Each individual in the study population was classified according to his or her family status (single, cohabiting, or married). In accordance with the classification provided by Statistics Finland, cohabitation is defined as a union of two unmarried adults of opposite sex aged 18 or over who have been living in the same dwelling for at least three months and who are neither siblings nor have an age difference of 16 years or more (Official Statistics of Finland (OSF) 2021a). Further, an individual is considered single if he or she is not living in a cohabiting or married union. Individuals with missing information on family status (e.g., the institutionalized population and/or otherwise unclassified) (2.1% of men and 1.5% of women) were excluded from the study.

In the analytical sample of sub-study III, yearly transitions were formed for all individuals in the study population living in Finland for (at least) two consecutive years and for whom personal information was available for these years. Individuals born abroad (n=229 670) were excluded to avoid challenges with incomplete information on educational attainment and the unknown number of unregistered first births to non-native Finns. Finally, a total of 19 468 815 yearly transitions between family states (single, cohabitating, married, and experiencing the first birth conditional on family state) for 2 125 172 individuals were identified from the year 2000 onwards. Among these transitions, 2 911 543 were transitions between partnership states and 740 537 were transitions to a first birth.

The individuals were further classified based on SES, and yearly transitions were estimated for different SES groups. Level of education was used as the primary measure of SES, partly due to the initial prediction of the SDT theory that new family demographic behaviour would be first adopted by the higher educated with more advanced post-materialist values, and partly because it is considered a proxy for economic resources. Four categories of educational attainment were considered — primary, secondary, lower tertiary, and higher tertiary. Primary level refers to those who have completed, at most, lower secondary education (ISCED 0–2), and the secondary level includes those with an upper secondary or a post-secondary non-tertiary qualification (ISCED 3–4). Tertiary education was further divided into the lower and higher tertiary levels: lower tertiary refers to those with a short-cycle tertiary education or a bachelor's or equivalent level degree (ISCED 5–6), and higher tertiary level includes master's, doctoral or equivalent degrees (ISCED 7–8).

To overcome the limitations related to using educational attainment as an explanatory variable in the period analysis — that is, many individuals at younger ages are still enrolled in education, and less educated groups include those who will later attain more advanced degrees — annual income was used as a complement to education as a robustness check in the original publication. Additionally, a sensitivity analysis that excluded students was preformed, as those enrolled in educational programmes are known to exhibit a lower likelihood of bearing children (e.g. Kravdal 1994). The income variable used as a robustness check refers to individual annual income subject to state taxation and includes both earnings and social-security benefits; four income groups were formed based on income quartiles stratified by age, year, and gender.

6.1.1 CATEGORIZATION OF EDUCATIONAL FIELDS

The sample used in sub-study IV comprised all women born in Finland who were aged 15–49 in 2000–2019 and permanently residing in Finland in any of these years. These individual-level data were used to identify detailed groups of educational fields, and these groups were subsequently used in aggregate-level regression analysis. The ISCED 2011 classification was used to separate between broad field and level of education. The level of education was classified in a similar manner to sub-study III. In order to form more detailed groups beyond the ISCED 2011 classification, a 6-digit code provided by Statistics Finland was used. Hence, it was possible to distinguish between, for instance, nurses, health care providers, and midwifes from the broad group of nursing and midwifery (ISCED 0913), or general teachers and special teachers from the broad group of trained teachers without subject specification (ISCED 0113).

A total number of 153 fields of education were identified[4]. One third of all women were educated in health and teaching, and around 20% were educated in the fields of business and social sciences. In turn, almost 13% were educated in the combined group of engineering, agriculture, ICT, and natural sciences, whereas another 13% were educated in the field of services, 12% in education and broad programmes and 10% in arts and humanities. The largest more detailed groups were nursing and business at the secondary and lower tertiary level, social work studies at the lower tertiary level, and hotel and restaurant studies at the secondary level. At the higher tertiary level, the largest fields consisted of women educated in business, general teachers, physicians, and lawyers.

[4] A list of the fields and a description of the education system in Finland can be found in the manuscript of sub-study IV.

6.1.2 FERTILITY OUTCOMES AND INDEPENDENT VARIABLES IN THE REGRESSION MODELS

For the 153 fields of education studied in sub-study IV, the total fertility rate (TFR) was calculated using 5-year age-specific fertility rates, while the share expected to experience a first birth (TFRp1) at some point in the life course was calculated using 5-year age-specific first-birth rates (first births per number of childless women) and a lifetable approach. To identify as many fields as possible and to increase the stability of the rates, the observations in 2009–2011 (the fertility peak) and 2017–2019 (latest available years) were grouped together. The main outcomes of interest were the changes in the TFR and TFRp1 between 2009–2011 and 2017–2019.

Characteristics of the field analysed in sub-study IV were the proportion of women unemployed (out of the labour force), mean annual income among the employed (on a log scale), and the share of women working in the public sector (out of the employed). These employment-related characteristics were measured in 2018 for women aged 25–29: early in their career and immediately before or at the prime age of childbearing.

6.2 METHODS

6.2.1 AGE AND PARITY DECOMPOSITIONS

Sub-studies I and II use various approaches that, independently of each other and from different angles, examine the period fertility decrease in the 2010s in the Nordic countries. First, time trends in fertility rates are described by five-year age groups, and a stepwise replacement method (Andreev, Shkolnikov, and Begun 2002; Andreev and Shkolnikov 2012) is used to decompose the difference in the TFR computed from conditional age- and parity-specific fertility rates (TFRp) in 2010 and 2018 into additive age and parity contributions. The TFRp adjusts for both the age and the parity composition of the female population and might therefore differ slightly from the conventional age-standardized TFR.

6.2.2 TEMPO AND QUANTUM CHANGES

Tempo adjustments to the TFR are applied to analyse the impact of changes in the timing of childbearing on the recent fertility decline using the method by Bongaarts and Sobotka (2012), denoted the TFR(BS). A decrease in the observed TFR can be attributed to accelerated fertility postponement if there is no decrease in the TFR(BS), while quantum changes are the main driver of the decline if the observed TFR and the TFR(BS) show similar decreases. Sub-study II applies the method developed by Bongaarts and Feeney (1998), denoted the TFR(BF), when data on the female parity distribution are lacking (as for Iceland before 2009). The TFR(BF) is a simple adjustment method, since it does not require data on female parity distribution, and it is also shown on the HFD. The TFR(BS) is considered an improvement on the TFR(BF) because it incorporates data on the female parity distribution and hence removes the additional distorting parity composition effect that influences the conventional TFR (Bongaarts and Sobotka 2012). It has been shown to exhibit smaller year-to-year fluctuations and to be a closer approximation of completed cohort fertility.

6.2.3 COHORT FERTILITY FORECASTING

While tempo adjustments can be used to decompose changes in period fertility into tempo and quantum effects, completed cohort fertility forecasting is another technique to detect fertility quantum changes. Sub-studies I (covering Finland) and II (covering the Nordic countries) use multiple forecasting methods to address the question of whether cohorts currently of childbearing age will ultimately have fewer children than earlier cohorts. The number of children is estimated by forecasting the remaining unobserved fertility rates for cohorts aged 30 and older with incomplete fertility schedules. While forecasted completed fertility for cohorts older than 35 depends little on the choice of forecasting method, forecasted completed fertility for cohorts aged 30–35 can vary greatly depending on the method used. By employing a variety of forecasting methods, the results avoid reliance on the assumptions of a single method.

First, the freeze rate method freezes the most recent observed age-specific fertility rates into the future and estimates what the completed cohort fertility would be if age-specific rates remained unchanged over the coming years. Second, the five-year extrapolation method (Myrskylä, Goldstein, and Cheng 2013) extrapolates the past five-year trend into the future and then freezes the rates. The extrapolation of trends performs well when older age fertility develops continuously over time, but the freeze rate method is preferable in the case of a sudden trend change. Finally, a Bayesian forecasting method (Schmertmann et al. 2014) that uses age-specific fertility rates from the HFD countries before 1960 as prior data produces a probabilistic forecast that automatically includes estimates of uncertainty and extrapolates trends in fertility rates over both time and age. These three forecasting methods are among the best-preforming cohort fertility forecasting methods (Bohk-Ewald, Li, and Myrskylä 2018) and are all applied in sub-studies I and II.

6.2.4 A NOVEL NONPARAMETRIC FORECASTING APPROACH

In sub-study I, a novel nonparametric approach was developed to address the problem of overly strict model-based assumptions regarding trends and age schedules in the Bayesian forecasting method, and consequently potentially over-narrow confidence intervals in times of abrupt trend changes. Bohk-Ewald, Li, and Myrskylä (2018) demonstrated that even the best preforming forecasting approaches produce relatively large forecasting errors when fertility patterns deviate from continuous trends or patterns seen in other countries, and methods to address this issue are lacking. In the Bayesian forecasting method, the prior distribution for typical fertility rates assumes that both the shapes of cohort schedules and the time-series of age-specific rates are as smooth as possible. Thus, rapid developments in age-specific fertility rates that would lead to unsmooth cohort schedules, or shapes not seen in historical data, are considered unlikely. The new nonparametric method does not make similar assumptions; rather, it allows age-specific fertility rates to change abruptly. This method estimates future cohort fertility developments based on recuperation paths observed in fertility histories without making modelling assumptions. For a cohort with observed age-specific fertility rates up to age x, the universe of fertility changes for ages above x is calculated from historical data, and these changes are added to the most recent year's fertility rates. The approach is based on work of Keyfitz (1985, 1989), Denton, Feaver, and Spencer (2005), and Dudel (2015) but is modified to fit the purpose of forecasting completed cohort fertility. To derive a probabilistic distribution of potential future fertility trajectories non-parametrically, the universe of fertility recuperation schedule is resampled with replacement (10,000 samples). In sub-study I and II, the nonparametric approach is applied using historical data since 1975 from the HFD, a period characterized by increasing older age fertility. Consequently, the median forecast produced by this method yields completed cohort fertility developments in which older age fertility increases.

6.2.5 A MARKOV CHAIN MULTISTATE APPROACH AND COUNTERFACTUAL SIMULATIONS

Sub-study III uses a Markov chain multistate approach (Briggs and Sculpher 1998) to describe the transition probabilities between the states of being single, cohabitating, married and experiencing the first birth among childless men and women in Finland. The Markov chain moves step-by-step in discrete time from state i to state j and has the property of being memoryless: the probability of each transition depends only on the state attained in the previous step and not on the full history of events (Kemeny and Snell 1971). The transition probabilities from state i to state j at a specific age and point in time are defined as

$$p_{ij}(age, t) = pr(State_t = j | State_{t-1} = i;\ age_{t-1}).$$

The step size in the analyses was one year, and the state space and the transitions are illustrated in Figure 3. Individuals can move freely between partnership states (single, cohabiting, married), but once they have experienced their first birth they are excluded from the study. To distinguish single parents from couples who move together close to the event of a first birth, the transitions from "single" to "first birth and single" and to "first birth and union" were considered. The yearly age-specific transition probabilities between the ages of 15 and 45 from year 2000 to 2018 were estimated as

$$p_{ij}(x, t) = \frac{\text{\#individuals in state } j \text{ in year } t \text{ aged } x \text{ and in state } i \text{ in year } t-1}{\text{\#individuals aged } x \text{ in state } i \text{ in year } t-1}.$$

The transition probabilities were estimated separately for men and women and for the SES group.

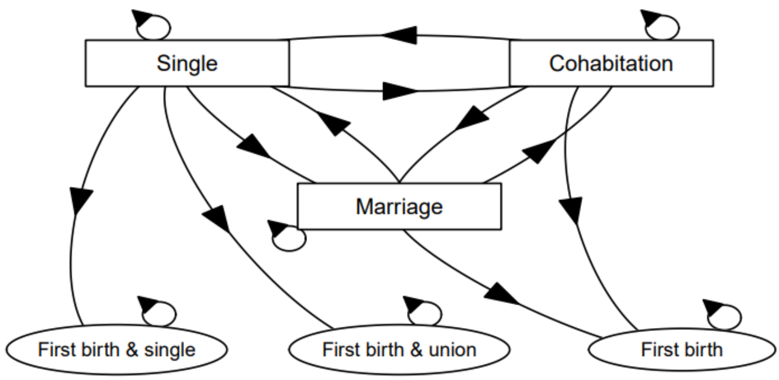

Figure 3 State transition diagram for the Markov chain.

The estimated transition probabilities and counterfactual simulations were used to estimate the proportion of the decline in first births that was attributable to changes in union dynamics versus the decline in fertility within unions in sub-study III. First, in the "constant probability births" scenario, age-specific first birth rates were calculated in a scenario where the population in 2010 experienced the 2010 transition probabilities throughout the period from 2010 to 2018. These age-specific first birth rates were then used to calculate the proportion experiencing a first birth at some point in the life course based on a life-table approach. Second, in the "natural course birth" scenario, age-specific first birth rates and the proportion experiencing a first birth at some point in the life course were calculated in a scenario where the population in 2010 experienced the observed changes in transition probabilities in 2010–2018. Finally, the difference between the expected proportions experiencing a first birth at some point in the life course in these two scenarios was decomposed by changing the value of the transition probabilities one at a time. For the analyses by education, the procedure was adjusted to take into account the fact that the study population evolves to higher levels of education over time.

6.2.6 REGRESSION ANALYSIS AND COUNTERFACTUAL PREDICTIONS

Sub-study IV used scatter plots with weighted trend lines (the weights were based on the size of the educational field at age 30–34) to illustrate the fertility decline by field and level of education. Further, weighted linear regression was used to analyse the association between the characteristics measuring employment uncertainty (unemployment rate, mean annual income, and the share working in the public sector) and the fertility decline within fields. These characteristics are strongly intertwined, but the regression approach allows analysis of the degree to which each factor matters net of other factors. To compare the predictive power of different predictors, the models were fitted to standardized data. Finally, counterfactual predictions were used to estimate the extent to which the fertility decline would have been reduced if factors reflecting uncertainty (e.g., unemployment) had been low.

7 RESULTS

The following results comparing different childbearing trends in the Nordic countries in sections 7.1–7.4.1 are found in sub-study II. Sub-study I contains similar results, but for Finland alone, and it also includes a more detailed description of the new non-parametric forecasting approach. Trends in union patterns and their contributions to the declining first births in the 2010s depicted in sections 7.5–7.6 are found in sub-study III. The main results from sub-study IV concerning the decline in fertility by field of education and its association with economic uncertainty are found in sections 7.7–7.8.1.

7.1 DEVELOPMENTS IN AGE-SPECIFIC FERTILITY IN 1990–2018

Figure 4 illustrates the developments in period fertility by five-year age group in the Nordic countries in 1990–2018. All Nordic countries show rather similar developments in age-specific fertility since the 1990. The timing of childbirth shifted to older ages: fertility rates at ages below 25 continuously decreased, while fertility at ages 30+ rose. In the early 1990s, fertility was highest in the age group 25–29, but, by 2010, childbearing had become most common in the age group 30–34 in most Nordic countries. Similarly, childbearing became more common in the age groups 35–39 and 40–44 than in the age groups 20–24 and 15–19. Most importantly, after 2010 fertility declined in nearly all age groups: childbearing intensities of women under 30 fell even more rapidly in than in the past, and the fertility rates of women aged 30–39 began to decline for the first time since the early 1970s. Finland, Norway and Iceland experienced stronger fertility declines than Sweden and Denmark. Consequently, it seems that fertility rates in the age group 20–24 and 25–29 are converging across the countries but diverging in the age group 30–34. Finland stands out for having the lowest fertility levels in the peak childbearing years of 25–34, while Denmark stands out for a slight recovery in recent years at ages over 30. Overall, the downward trend among women at ages 30–39 implies that the fertility recuperation pattern typical of the Nordic countries is weakening and suggests that the fertility quantum is decreasing. Women at later reproductive ages are at higher risk of experiencing infertility, and, consequently, the prospects for stable cohort fertility in the near future are diminishing.

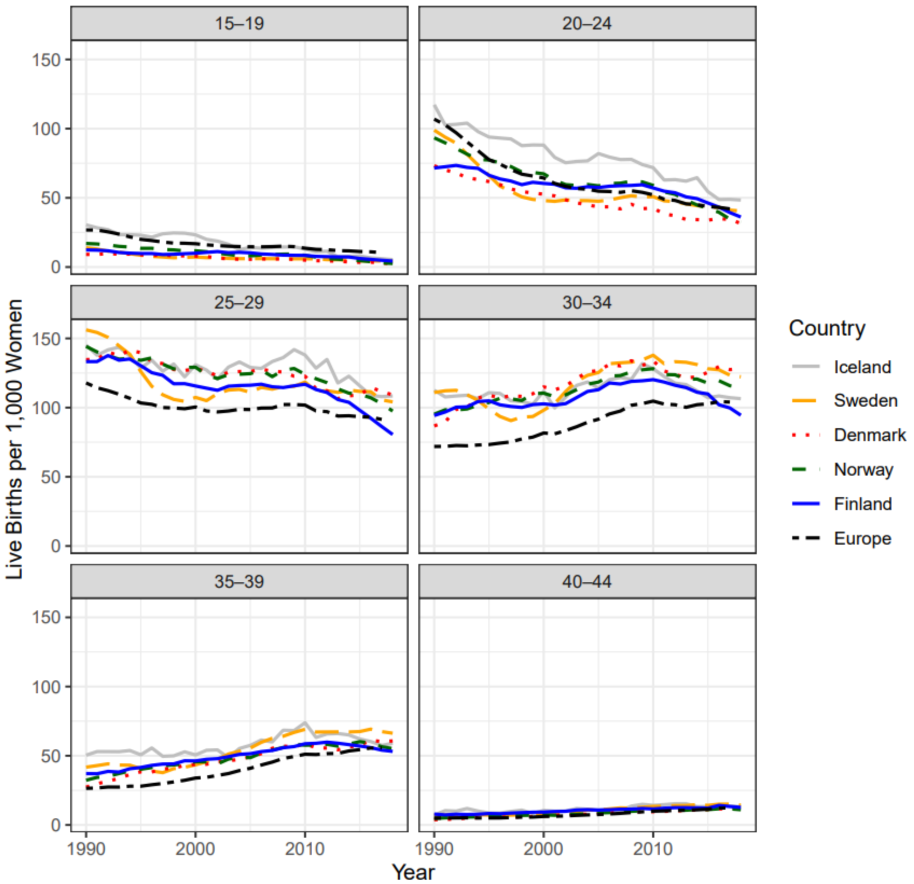

Figure 4 Age-specific fertility rates in the Nordic countries in 1990–2018. European countries include Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.

7.2 AGE AND PARITY CONTRIBUTIONS TO THE PERIOD FERTILITY DECLINE

To answer the question of what age groups and parities contributed to the recent period fertility decline, Figure 5 decomposes the difference in the age- and parity-adjusted TFRp in 2010 and 2018 into additive age and parity contributions. The size of the decomposed decline varies between the Nordic countries: for instance, the TFRp fell from 1.86 to 1.39 in Finland, and from 1.89 to 1.74 in Denmark. Nevertheless, the greatest contributions to these declines come from decreasing first-birth intensities in all countries. Of the total decline, decreasing first-birth intensities explain 91% in Denmark, 87% in Sweden, 83% in Norway, 75% in Finland, and 57% in Iceland. The contribution of the first-birth decline to the decline in TFRp is largest at ages below 30, but first-birth intensities have also decreased at ages 30+ in all Nordic countries except Iceland. Hence, family formation is increasingly postponed among women in their early 30s, which is a new trend in the Nordic countries.

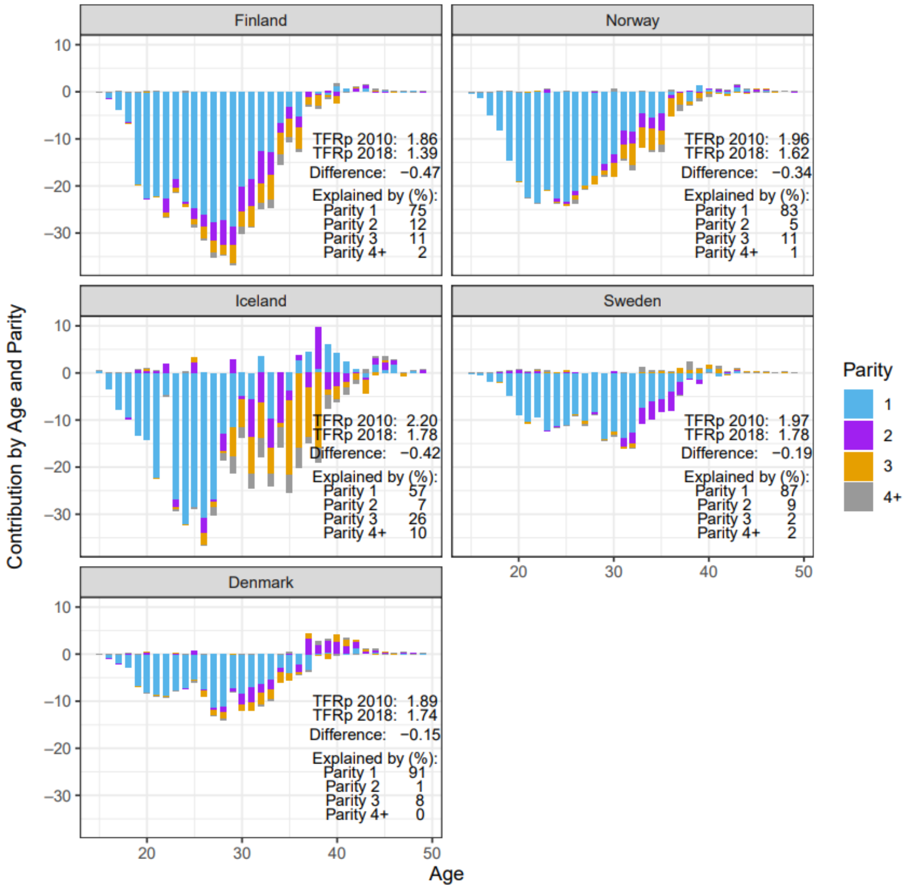

Figure 5 Decomposition of the decrease in the age- and parity-adjusted TFR (TFRp) in the Nordic countries in 2010–2018 by age and parity.

Higher order childbearing has also decreased in the Nordic countries, but its contribution to the total decline in fertility is relatively small. Across all countries, second births explain less than 13% of the total decline. The contributions of parity 3 and higher are also small, but Iceland is an exception, where one-quarter of the total decline is attributable to declining third births and an additional 10% to declining fourth and higher order births. When comparing the parity-contributions at ages 30+, the contribution of higher-order births is larger than at younger ages: declines in second and higher-order births explain nearly all the decline in Iceland and about 50% of the decline in Finland and Norway. Only women close to the end of their reproductive years in some of the countries contributed positively to the fertility change, albeit very modestly. Second births in Denmark and first and second birth intensities in Iceland increased somewhat at ages around 40, but almost no increases in older age fertility were observed in the rest of the Nordic countries. The new trend in postponing the first birth among women in their early 30s together with weak signs of fertility increases at older ages reduces the prospects of fertility recuperation in the coming years in the Nordic countries.

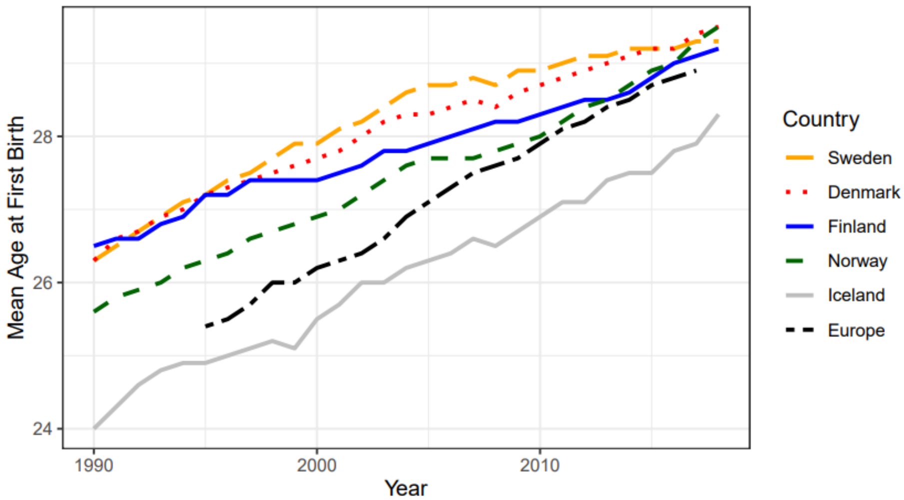

Figure 6 Mean age at first birth in 1990–2018 in the Nordic countries and Europe. European countries include Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United Kingdom.

7.3 FERTILITY TIMING AND TEMPO ADJUSTMENTS

As one of the main focuses of this study was to determine whether the decline in period fertility since 2010 can be explained by accelerated fertility postponement, the development in the mean age of first childbearing from 1990 to 2018 is shown in Figure 6. During this period, all Nordic countries experienced an increase in the mean age of first childbearing, but the speed of the increase varied to some extent across countries and periods. For instance, Finland experienced a total increase of only 2.8 years starting from a relatively high mean age of around 26.5 years in 1990, while Iceland experienced a fast increase of 4.4 years starting from a young age of 24 years in 1990. After 2010, an accelerating increase in the mean age at first birth occurred mainly in Norway and to some extent in Finland, but the increase in the mean age of first birth remained steady or even slowed (Sweden) in the other Nordic countries compared to the period before 2010. The mean age at first birth rose by 1.5 years in Norway compared to less than 0.5 years in Sweden. Movements in the age at first birth are considered a proxy for fertility postponement, but note that this is based on the assumption that fertility recovers at older ages (which is yet to be observed) and should therefore be read with caution.

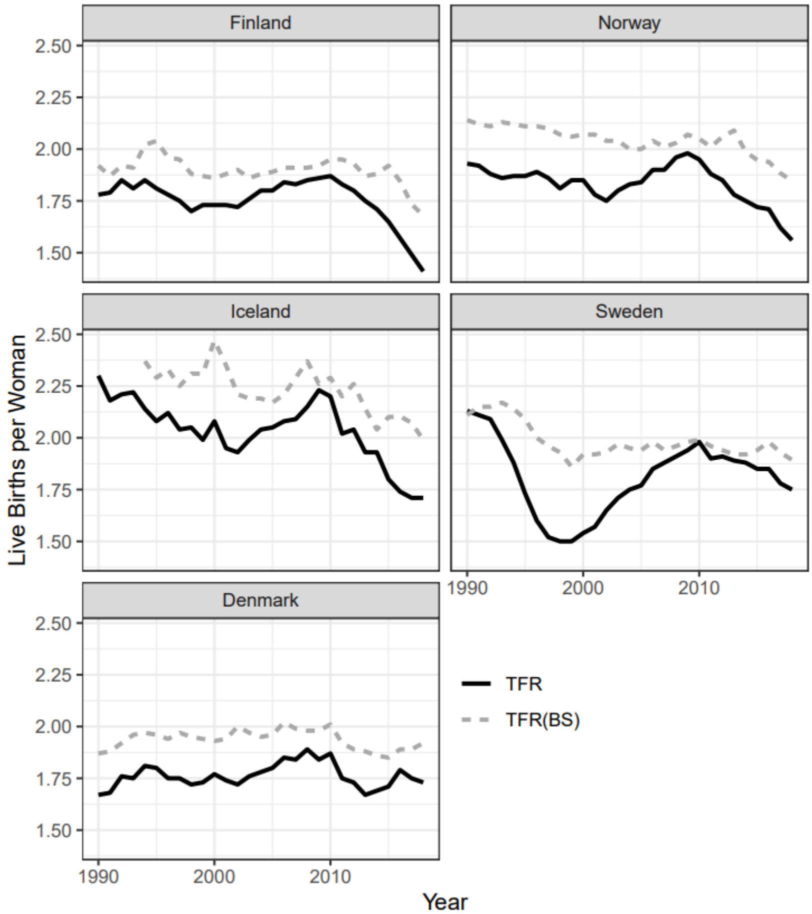

Figure 7 Observed TFR and tempo- and parity-adjusted TFR, TFR(BS), in 1990–2018 in the Nordic countries. For Iceland, the tempo-adjusted TFR, TFR(BF), for the years up to 2008 is used.

To analyse the impact of changes in fertility timing on the recent fertility decline, the tempo- and parity-adjusted TFR, TFR(BS), is shown in Figure 7. The TFR(BS) has been consistently higher than the conventional TFR in all Nordic countries since 1990. Hence, as illustrated by this gap, the TFR would have been higher than observed levels in the absence of fertility postponement. If fertility had not shifted to older ages, the TFR would have been rather stable at around 2 children in all countries in the 2000s, and no lower than around 1.7 in any year in the period 1990–2018. However, the TFR(BS) decreased almost in tandem with the TFR from 2010, especially in Finland, Iceland, and Norway. For instance, the TFR(BS) dropped from 1.95 to 1.68 in Finland and from 2.05 to 1.85 in Norway. These findings suggest that changes in the speed of fertility postponement alone cannot explain the period fertility decline; rather, the quantum of fertility is decreasing as well. Nonetheless, the gap between the TFR and TFR(BS) observable also in the 2010s implies that period fertility levels continue to be suppressed due to postponement of childbearing to older ages.

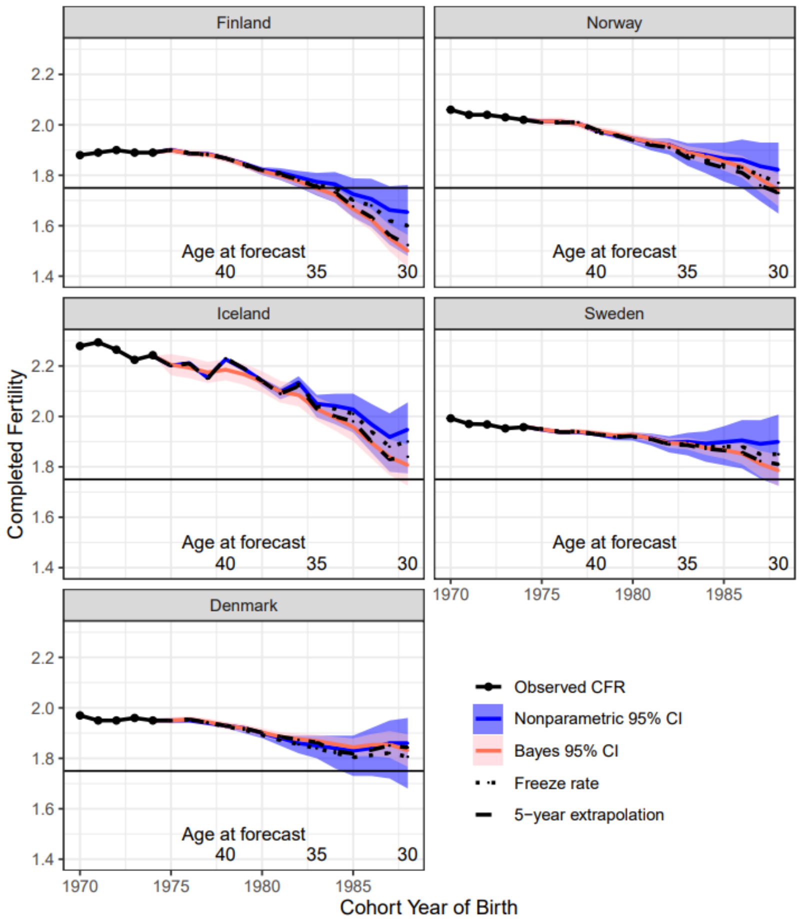

Figure 8 Observed completed cohort fertility rate (CFR) for 1970–1974 cohorts and forecasted CFR for 1975–1988 cohorts in the Nordic countries. The unbroken black line indicates the threshold for very low fertility, at 1.75. CI=confidence interval.

7.4 COHORT FERTILITY

Figure 8 shows the observed cohort completed fertility for women born in 1970–1974 and the forecasted cohort completed fertility for women born in 1975–1988 in the Nordic countries. All forecasting methods predict declining cohort fertility among women currently at childbearing age in all Nordic countries, but the strength of the decline differs between countries and methods. Moreover, regardless of the method used, forecasts indicate that cohort fertility will decline slowly or even stabilize in Denmark and Sweden, but will decrease strongly in Finland, Iceland, and Norway. Finland's cohort fertility is predicted to fall substantially below 1.75, which marks the threshold between low and very low cohort fertility (Zeman et al. 2018).

The freeze rate approach assumes that the current period fertility levels (in 2018) will persist into the future. This method yields completed fertility estimates for the youngest cohort of 1.60 in Finland, 1.77 in Norway, 1.81 in Denmark, 1.85 in Sweden, and 1.90 in Iceland. On average, the freeze rate method produces a decline from 2.0 to an all-time low of 1.8 in the Nordic countries. During previous decades when fertility was shifting to older ages, the freeze rate method was criticized for underestimating completed fertility. However, under current circumstances when the long-term increasing trend in older age fertility has turned negative and when it is uncertain whether this trend change is temporary or permanent, the freeze rate method is a reasonable approach. The five-year extrapolation and Bayesian approaches rely on the extrapolation of trends and represent future cohort fertility developments if older age fertility continues to decrease. Consequently, these methods produce lower estimated cohort fertility than the freeze rate method. The forecasting results indicate that unless older age fertility recovers rapidly, cohort fertility will decline considerably in the Nordic countries in the near future.

7.4.1 POTENTIAL FOR RECUPERATION OF COHORT FERTILITY

A new non-parametric approach was developed to investigate the likelihood that older-age fertility will recover fast enough to prevent strong decreases in cohort fertility in the Nordic countries. Unlike the Bayesian method, the non-parametric approach does not impose any restrictions on the smoothness or shape of fertility schedules; rather, it allows for the possibility that sharp recoveries could occur. The changes in age-specific fertility rates in all HFD countries were calculated since 1975, when older-age fertility was typically increasing, and applied to the incomplete cohort fertility schedules in the Nordic countries. Hence, the median forecast represents a scenario of increasing older-age fertility – in line with the main pattern in the historical data.

The weakest declines in cohort fertility are observed when this method is applied, but even this method suggests a reduction in fertility: the 95% confidence interval for the youngest cohort includes cohort fertility estimates at 1.48–1.76 in Finland, 1.65–1.93 in Norway, 1.77–2.06 in Iceland, 1.73–2.01 in Sweden, and 1.68–1.96 in Denmark (Figure 8). In other words, and taking Finland as an example, a recuperation pattern that would maintain Finnish cohort fertility at 1.76 or above has only been observed in 2.5% of the trajectories in the past. In order to keep cohort fertility stable in Finland, Norway and Iceland, a recuperation pattern that is stronger than any patterns observed in the historical data is required. The strongest recuperation patterns seen in the historical data would cause cohort fertility to recover for the youngest cohorts in Denmark and Sweden. Comparing the confidence intervals of the methods, that of the non-parametric approach is much wider than that of the Bayesian method due to its looser assumptions. This is desirable given that existing forecasting methods may produce overly narrow confidence intervals, especially in times of trend changes, although the Bayesian method performed relatively well in a large scale evaluation (Bohk-Ewald, Li, and Myrskylä 2018).

To sum up, all methods produce similar conclusions: overall Nordic cohort fertility will decline, but not necessarily strongly in Denmark and Sweden. The nonparametric approach produces the most optimistic scenario; the 5-year extrapolation and the Bayesian indicate most strongly declining trends, and the freeze rate method produces forecasts that lie in between these two extremes. When comparing (using the most "neutral" freeze-rate approach) the forecasted decline for women aged 30 in 2010–2018 (i.e., 1980–1988 cohorts) with the period fertility decline in the 2010s, the strength of magnitude of the cohort fertility decline is about half the strength of the period fertility decline. Further, the magnitude of the TFR(BS) decline in the 2010s is similar to that of the projected cohort fertility decline. This implies that approximately half the decline is attributable to tempo effects and half to quantum effects.

7.5 TRENDS IN UNION PATTERNS AND THE FIRST BIRTH IN FINLAND

As first births were shown to explain most of the period fertility decline in the 2010s, trends in partnership patterns and first birth are examined in this section. Figure 9 shows the trends in age-specific transition probabilities between the states of single life, cohabitation, marriage, and experiencing the first birth among childless men and women in Finland in 2000–2018. Trends are shown for two selected age groups – 25-year-olds and 35-year-olds – to represent the development in both younger and older age groups.

7.5.1 UNION FORMATION

Union formation refers to the formation of both cohabitation (the transition from being single to cohabiting) and marriage (the transition from cohabitation to marriage). The transition from single life to marriage remains a rare event, given that most first unions begin with cohabitation (Jalovaara

2012), and this phenomenon became even rarer during this period. By contrast, the probability of transitioning to marriage from cohabitating unions remained relatively stable at all ages from the early 2000s. However, for people aged 25 or below, a drop occurred in the most recent years in the data (2015–2018) among both men and women: among men the transition probability fell from 14% to 12% at age 25. In other words, the yearly probability of remaining single has recently increased among younger individuals, which is in line with the accelerating increase in single living witnessed during the most recent years (Official Statistics of Finland (OSF) 2018b). Among childless individuals, the probability of marrying continuously declined throughout 2000–2018. For instance, the probability of marrying at age 25 across cohabiting women decreased from 11% to 6% in this period.

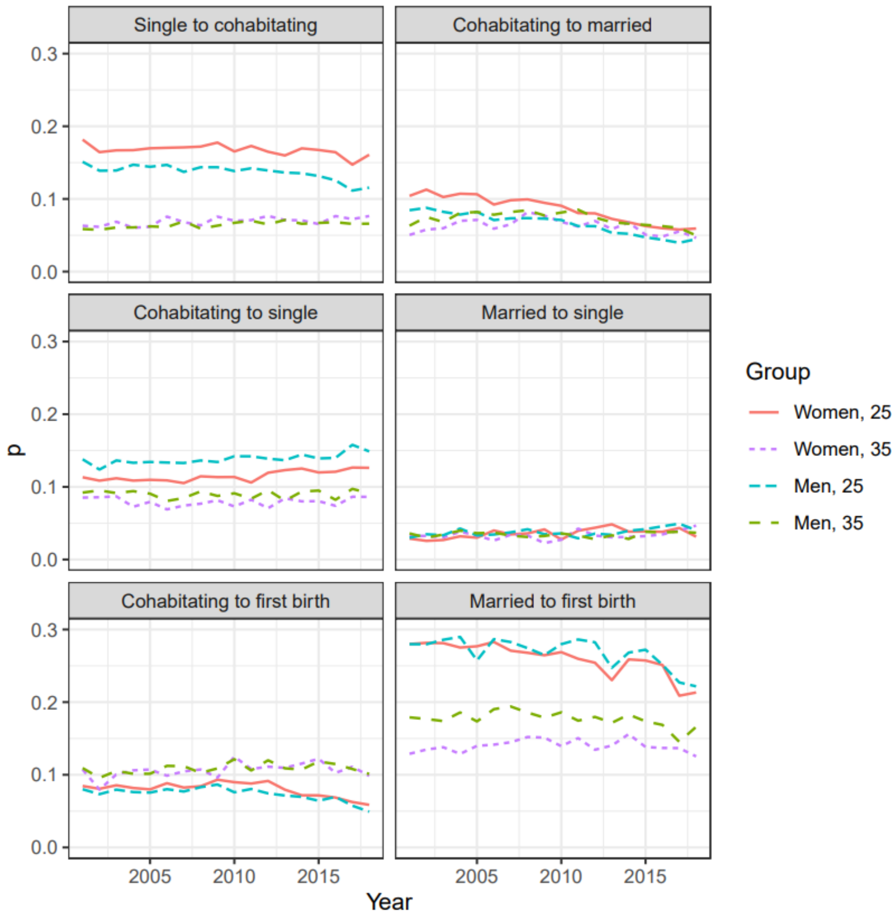

Figure 9 Transition probabilities for single, cohabitating, and married individuals, and the first birth for childless women and men aged 25 and 35 in Finland, 2001–2018.

7.5.2 UNION DISSOLUTION

The trends in union dissolution are shown for both married and cohabitating individuals (Figure 9). Married couples exhibit a lower risk of union dissolution than cohabitating couples. The probability of union dissolution among married couples also remains relatively similar across age groups, while among cohabitating couples the probability of union dissolution is highest at younger ages and decreases with age. Dissolution rates among married individuals have remained relatively stable over time, but the probability of union dissolution among cohabitating men and women has slightly increased in recent years at the younger ages. At age 25, the transition from cohabitation to being single rose in 2010–2018 from 11% to 13% among women and from 14% to 15% percent among men. Furthermore, in the event of divorce, it remains rare that an individual will cohabit in the following year (the transition from marriage to cohabitation).

7.5.3 TRANSITION TO FIRST BIRTHS

There are significant age-pattern differences in the transition to first birth between cohabitating and married couples: the transition from cohabitation to first birth is highest in the early 30s, while first birth transitions are highest at very young ages among married men and women. From 2010, first birth transitions decreased among both cohabiting and married couples at nearly all ages, but this reduction was more pronounced among cohabitating women and men. For instance, the first birth transition probability at age 25 decreased from 0.27 to 0.21 among married women and from 0.09 to 0.06 among cohabitating women. In addition, the already low probability of single individuals experiencing a first birth further decreased. Furthermore, the probability of remaining in a union (both cohabiting and married) without transition to a first birth increased sharply.

7.5.4 TRENDS IN TRANSITION PROBABILITIES BY SOCIOECONOMIC STATUS (SES) GROUPS

The changes in union patterns and first birth transitions were further explored by educational level, as shown in Figure 10. The results are presented for the least and the most educated groups. The decrease in nonmarried, cohabitating union formation was observed primarily among less educated groups of men and women. In 2010–2018, the probability of transitioning from single life to cohabitation at age 25 declined for men and women educated to the primary level by 5 and 3 percentage points respectively. By contrast, barely any change was observed among higher tertiary-level educated men and women. A long-term decrease in marriage rates was observed across SES groups, but this fall was somewhat stronger among more highly educated individuals: the probability of transitioning from cohabitation to marriage fell from 0.18% to 0.10% for higher tertiary educated women but remained stable at around just 0.05% for women educated to primary level. Further, a slight increase in dissolution rates among cohabiting couples was observed, mainly among the least educated men and women, and a small potential increase in divorce rates at younger ages was found exclusively among the least educated. Finally, all SES groups experienced a decrease in first birth transitions both among cohabitating and married couples.

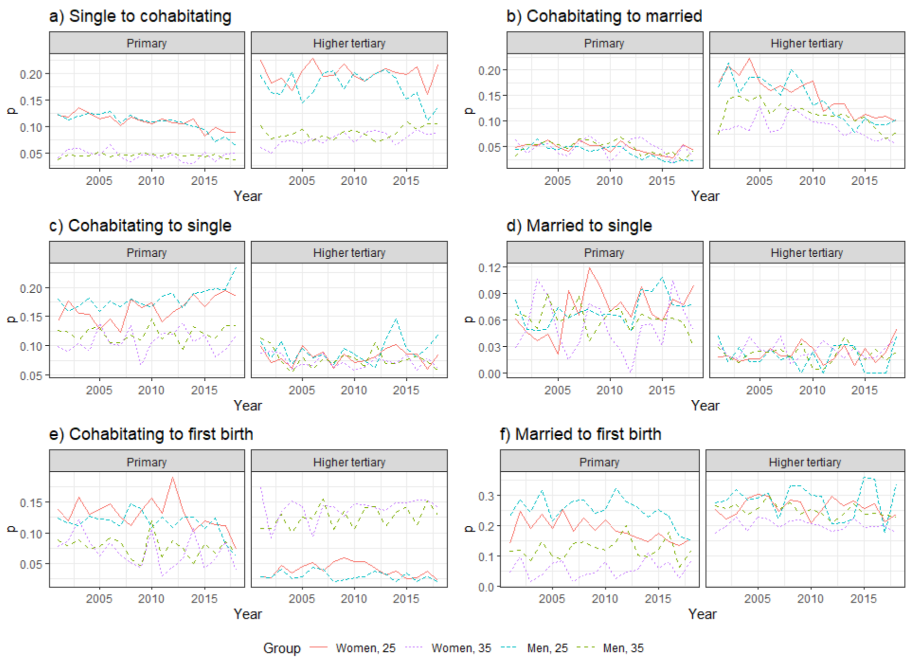

Figure 10 Transition probabilities for single, cohabitating, and married individuals, and for first births among childless women and men in 2001–2018 by level of education at ages 25 and 35.

7.6 CONTRIBUTIONS TO DECLINING FIRST BIRTHS, 2010–2018

The contributions of the changes in union formation, union dissolution and first birth transitions across partnership states to the decline in the total number of first births in 2010–2018 are shown in Figure 11. The outcome is presented as the percentage of people experiencing a first birth calculated based on age-specific transition rates; this is a synthetic measure indicating the proportion of people who are expected to experience a first birth at some point in the life course based on these rates. The observed changes in transition probabilities indicate a decline in the share experiencing a first birth from close to 80% to 68% among women, and from above 72% to 58% among men. Stable probabilities (i.e., as observed in 2010), would have resulted in a stable share experiencing a first birth in 2018 of 78.6% for women and 71.2% for men. In a counterfactual scenario where first birth transitions (whether among single, cohabitating, or married individuals) had not decreased, 76% of the observed decline in the share experiencing a first birth among women would have been eliminated. Of these first birth transitions, cohabitating women contributed the most to the decline (42%), followed by single women who in the following year experienced their first birth and lived in a union (17%), married women (13%), and single mothers (4%).

Furthermore, in a counterfactual scenario where union formation had remained stable, the decrease would have been reduced by 21%: 19% was attributable to decreasing marriage rates and only 2% to decreasing cohabitation rates. In a setting like Finland, where the first birth often occurs before marriage, it is possible that marriage decreased because couples simply did not experience the first birth (i.e., declining childbearing intentions led to a decline in marriage) rather than decreased marriage formation leading to fewer first births. Moreover, the contribution of increased dissolution rates to the first birth decline was 6%. The results were largely similar for men, but, for instance, the decrease in cohabitation rates was somewhat more important among men than among women.

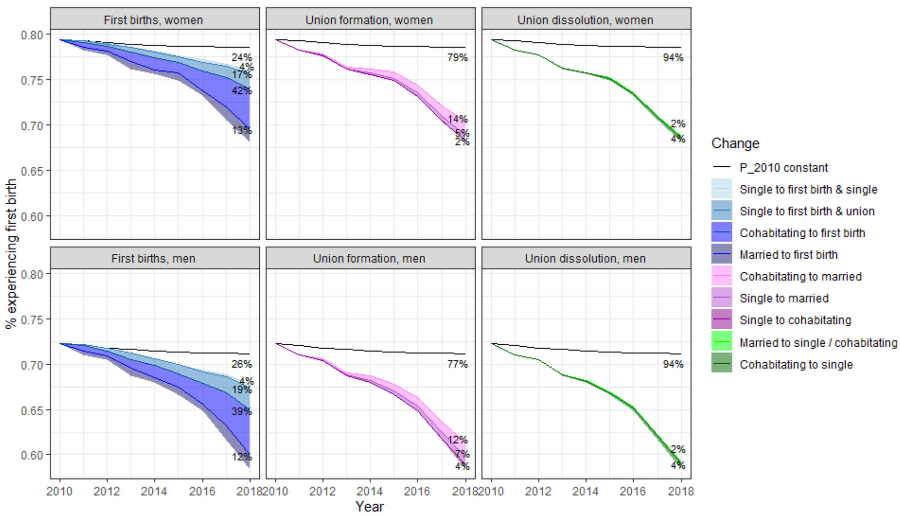

Figure 11 Contributions of declining first births, changes in union formations, and changes in union dissolutions to the decline in the percentage experiencing first births based on the first birth rates in 2010–2018. The black solid line indicates the percentage experiencing a first birth that would have been observed if the population in 2010 had experienced the 2010 transition rates in the years 2010 through 2018. Shaded areas indicate how much the decline in first births would have been reduced if the corresponding transition probabilities had not changed.

The contributions to declining first births were further examined by socioeconomic status (Figure 12). First, the total decline in first birth was larger in lower SES groups. The expected share experiencing a first birth at some point in the life course fell in 2010–2018 from 65% to 48% for women with a primary education, and from 82% to 75% for women with a higher tertiary education. Further, the contribution of changes in first-birth transitions versus changes in unions to the declining first birth rate was generally similar across all SES groups, but some differences emerged. First, declining first birth transitions among married women explained a larger share (27%) of the total decline in first births among the higher educated compared to 7% among those who had completed primary education. This difference reflects both more strongly declining first-birth rates among higher educated married individuals and the fact that a much higher share of more highly educated childless individuals are married. Second, the declining transition to single motherhood was more important for the least educated women.

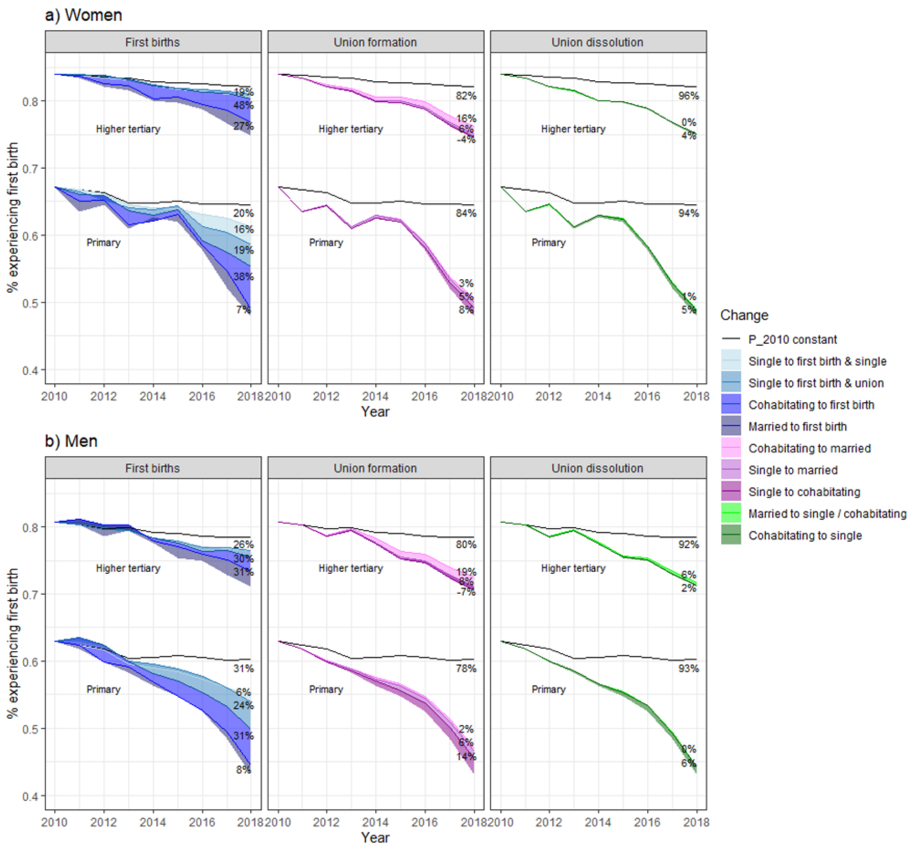

Figure 12 Contributions of declining first births, changes in union formations, and changes in union dissolutions to the decline in the percentage experiencing first births based on the first birth rates in 2010–2018 by education group. The top curve shows the results for the higher tertiary education groups, while the bottom curve shows the results for the primary-level education groups.

Regarding union formation, declining cohabitation rates explained more of the total decline in first births among the least educated. By contrast, the contribution of changes in cohabitation rates was, in fact, slightly negative among higher educated women, indicating that cohabitation rates have increased in this group, and, in the absence of this increase, first births would have decreased slightly faster. It is noteworthy that this is also the result of a decrease in cohabitation rates at younger ages, when most individuals have not yet reached tertiary education. The results across SES groups were generally similar for men. However, declining cohabitation rates among the least educated were slightly more important among men. Moreover, the contribution of decreasing single parenthood was not concentrated within any education group for men.

7.7 FERTILITY DECLINE BY FIELD OF EDUCATION

Figure 13 shows the trends in TFR and the TFRp1 in 2004–2019 as well as the TFR and the TFRp1 trends relative to the levels in 2010 by level and broad field of education. The highest TFR and TFRp1 levels were observed in health and teaching, and the lowest levels in arts and humanities, ICT, and general education. Before the onset of the fertility decline (around 2010), the TFR was 2.22 and the TFRp1 was 0.85 among secondary-educated women educated in the field of health and welfare, whereas women with only general education or those educated in ICT exhibited a TFR of 1.35–1.40 and a TFRp1 of 0.63–0.65. Among the higher-tertiary educated, the TFR and TFRp1 varied from 2.51 and 0.90 for women educated in teaching to 1.70-1.73 and 0.75-0.78 for women educated in ICT and arts and humanities.

While the declines in the TFR in the 2010s were rather similar by level of education, the declines in TFRp1 were somewhat more pronounced among women educated to the secondary level than among the higher tertiary educated (and the most pronounced among those with only a basic education, as shown earlier). Most worthy of note was that the variation in the strength of the decline by field of education was much larger than by level of education: fields with initially lower levels observed stronger declines, and fields with initially higher levels observed weaker declines. The variation across fields appeared larger among the secondary and the lower-tertiary educated than among the higher-tertiary educated. The strength of the TFR decline varied from around 23% among women educated in health, welfare, and agriculture at all levels, to the strongest declines in ICT, arts and humanities and general education at the secondary level (34–39%), in ICT at the lower-tertiary level (more than 40%), and in ICT, natural sciences and engineering at the higher-tertiary level (31–35%).

Regarding the declines in TFRp1, at the secondary level the strongest decline was observed in ICT (40%), followed by general education and arts and humanities (27%), and the weakest decline was observed in health and welfare (12%). Among the higher-tertiary educated, the strength of the decline in the TFRp1 varied from the weakest declines (4–7%) in agriculture, health and welfare, and education, to 10–12% in engineering, ICT, and arts and humanities, and further to 16% in natural sciences.

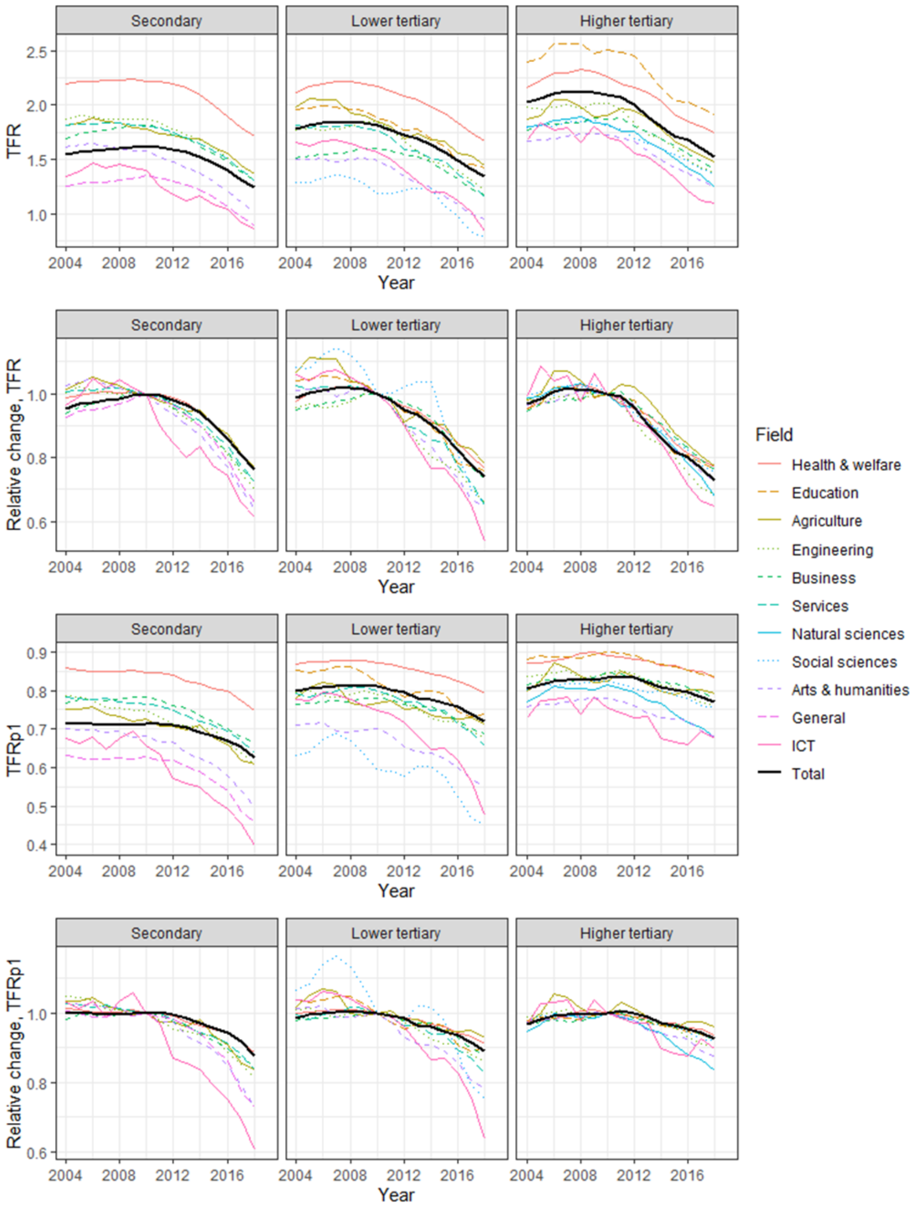

Figure 13 TFR (three-year moving average), relative change (baseline 2010) in TFR, TFRp1 (three-year moving average), and relative change in TFRp1 (baseline 2010) by level and field of education in 2004–2018.

Figure 14 illustrates the relationship between the initial fertility level (in the TFR and TFRp1) in 2009–2011 and the relative decline in the 2010s by detailed field of education. Similar patterns to those found in the broad field of education emerge: the strongest fertility declines are generally in those fields with the lowest initial fertility levels before the onset of the fertility decline (e.g., fine arts, librarians, and ICT), and the strength of the fertility decline decreases with a higher initial fertility level. This pattern is especially pronounced for the secondary and the lower tertiary educated and particularly so for the decline in TFRp1; however, this is not the case for the decline in the TFR at the higher-tertiary level. This divergence in TFRp1 patterns is seen also in the declines in absolute terms, while the TFR declines in absolute terms are more similar across fields (results shown in the original article).

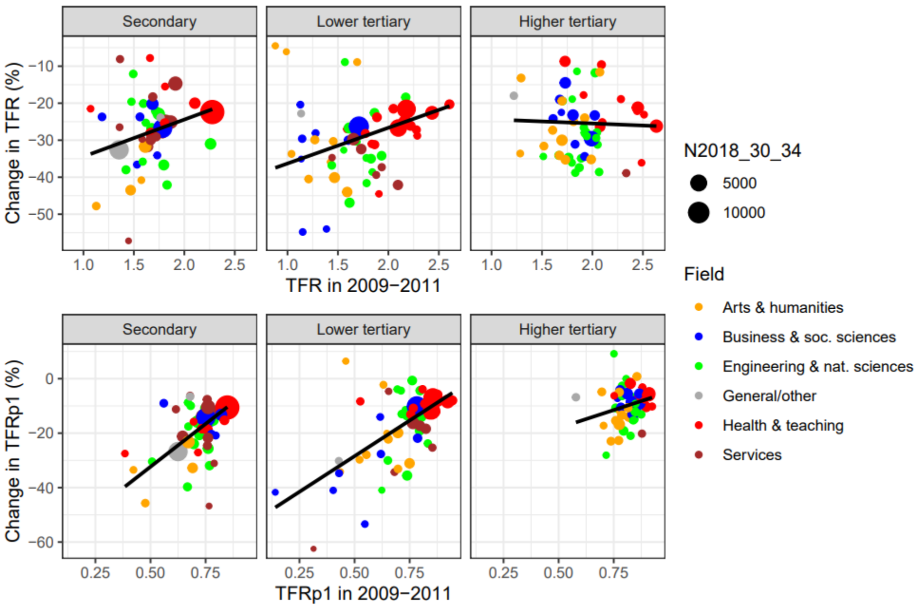

Figure 14 Top panel: TFR in 2009–2011 on the x-axis and the relative change in TFR in the 2010s on the y-axis by level and field of education. Bottom panel: TFRp1 in 2009–2011 on the x-axis and the relative change in TFRp1 in the 2010s on the y-axis by level and detailed field of education. The regression slopes are weighted by the size of the field. Note: Some of the groups contained low numbers of childless individuals in certain age groups, and the number of age groups that the TFRp1 is based on therefore differs across fields. Consequently, the extremely low levels (e.g., 0.14 in law at the lower tertiary level in 2009-2011) in some small fields should be read with caution. Nonetheless, for each group, the TFRp1 is calculated based on the same number of age groups over time. Further, excluding those small fields where the TFRp1 is based on only a small number of age groups did not significantly change the results.

7.8 FERTILITY DECLINE AND ECONOMIC UNCERTAINTY BY FIELD OF EDUCATION

To answer the question of how current characteristics reflecting uncertainty predict fertility declines in that field, the relationship between the share of unemployed women, mean annual income, and the share women working in the public sector and the relative change in the TFR and TFRp1 across fields is shown in Table 1 and Table 2. All variables are standardized (a change of one standard deviation in the predictor is associated with a change of β standard deviations of the change in fertility) to allow comparison of the predictors. As shown in the bivariate analyses, the changes in the TFR and the TFRp1 are associated with all three measures of uncertainty, but especially with unemployment. The strength of the fertility declines increases with higher unemployment and a lower mean income, whereas it decreases when there is a higher share of women working in the public sector.

Table 1 *Regression models estimating the relative change in TFR in the 2010s. In the separate models for each predictor, educational level is included. All models are weighted by size of field.*

	Separate models		***Multivariate model***	***Multivariate model with interactions***
	Estimate	R^2	*Estimate*	*Estimate*
Intercept			0.36***	0.22
Unemployment	-0.40***	0.17	-0.33***	-0.32*
log(Income)	0.23**	0.06	0.00	-0.21
Public sector	0.25***	0.14	0.19***	0.19 .
Education (ref: Secondary)				
Lower tertiary			-0.54***	-0.42*
Higher tertiary			-0.35 .	-0.23
Education interactions (ref: Secondary)				
Lower tertiary:Unemployment				-0.03
Higher tertiary:Unemployment				-0.26
Lower tertiary:log(Income)				0.22
Higher tertiary:log(Income)				0.13
Lower tertiary:Public sector				0.02
Higher tertiary:Public sector				-0.01
R^2			0.24	0.25
Adjusted R^2			0.22	0.19

*** p <= 0.001, ** p <= 0.01, * p <= 0.05, . p <= 0.1

Removing educational level from the multivariate model reduces R^2 by 8 percentage points.

To assess the extent to which the combined predictors explain the variation in the fertility decline between fields, all three predictors are included in multivariate regression models. These uncertainty models explain 24% of the variation in the TFR across fields and 40% in the TFRp1. Net of all uncertainty measures, unemployment is the strongest predictor, and the effect of income is no longer significant. The effect of public sector work remains significant, but the coefficient is somewhat smaller than in the univariate model. Table 1 and Table 2 also include the results of the uncertainty model including interactions between the uncertainty measures and education level, as this model is used in further analysis. As sensitivity checks, the original publication includes results of the model with additional predictors (occupational match, proportions in unions, and the proportion of students), but the associations between the uncertainty measures and the fertility declines remain rather similar when these factors are controlled for, although union status attenuates the effects of the uncertainty measures to some extent.

Table 2 *Regression models estimating the relative change in TFRp1 in the 2010s. In the separate models for each predictor, educational level is included. All models are weighted by size of field.*

	Separate models		***Multivariate model***	***Multivariate model with interactions***
	Estimate	R^2	*Estimate*	*Estimate*
Intercept			0.17*	0.12
Unemployment	-0.45***	0.37	-0.36***	-0.41***
log(Income)	0.32***	0.23	0.07	-0.03
Public sector	0.19***	0.23	0.12**	0.16 .
Education (ref: Secondary)				
Lower tertiary			-0.11	-0.02
Higher tertiary			0.13	0.31
Education interactions (ref: Secondary)				
Lower tertiary:Unemployment				0.20
Higher tertiary:Unemployment				-0.03
Lower tertiary:log(Income)				0.34
Higher tertiary:log(Income)				-0.01
Lower tertiary:Public sector				-0.02
Higher tertiary:Public sector				-0.12
R^2			0.40	0.42
Adjusted R^2			0.38	0.37

*** p <= 0.001, ** p <= 0.01, * p <= 0.05, . p <= 0.1

Removing educational level from the multivariate model reduces R^2 by 1 percentage point.

7.8.1 PREDICTED DECLINES AND COUNTERFACTUAL SCENARIOS

Figure 15 shows the observed and predicted declines based on the uncertainty models with interactions. Typically, the uncertainty models correctly predicted the stronger fertility declines in some fields in arts and humanities, engineering, and natural sciences, the intermediate decline in business, and the weaker decline in health and teaching. However, the model systematically underpredicted both the most severe and the very weakest declines in fertility. This was especially the case for the strong decline in the TFRp1 in natural sciences at the tertiary level.

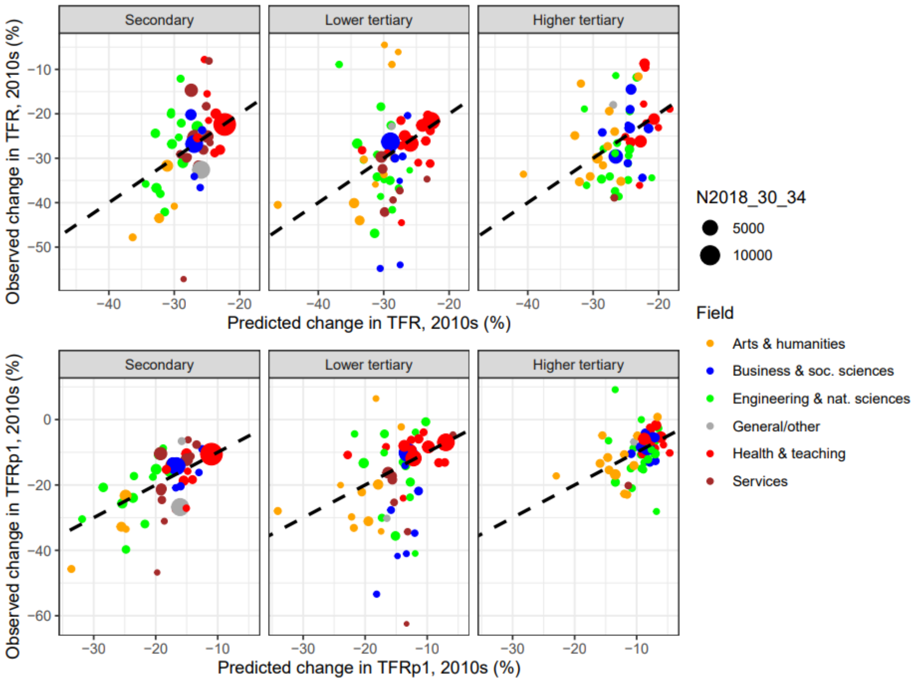

Figure 15 Observed (y-axis) and predicted change (x-axis) in TFR and TFRp1 in the 2010s based on the uncertainty model (with interactions) in Table 1 and 2 by level and detailed field of education.

Further, counterfactual scenarios were applied to estimate the extent to which the fertility decline would have been reduced in a scenario with low uncertainty (Figure 16). Unemployment was set to the minimum rate observed at a given level (1.1% at the secondary level, and 0% at the tertiary level), and the share working in the public sector was set to the maximum share observed at a given level (69.7% at the secondary level and around 94% at the tertiary level). This scenario is meaningful for illustrating the differences in the fertility decline associated with these uncertainty factors rather than as a plausible future scenario for Finland. The light blue dotted line represents fertility declines in a scenario where unemployment is low, and the dark blue dotted line represents the scenario where, additionally, public sector work is common.

On average, low uncertainty in all fields would have reduced the TFR decline from -26.2 to -19.2% for the secondary educated, from -27.6 to -21.5 for the lower-tertiary educated, and from -25.4 to -18.5% for the higher-tertiary educated. On average, the decline in the TFRp1 would have been reduced from -16.6 to -7.5% for the secondary educated, from -12.8 to -8.1%

for the lower-tertiary educated, and from -9.3 to -4.8% for the higher-tertiary educated. Hence, the TFR reduction in a low-uncertainty scenario is mid-sized (a reduction of one fourth), while the TFRp1 reduction is larger (a reduction of 50% at the secondary and higher-tertiary level, and one third at the lower-tertiary level). Low unemployment reduced the declines more than high public sector work among the secondary and higher-tertiary educated, but, for the lower-tertiary educated, high public sector work reduced the decline more. Additionally, income was set to the highest value at a given educational level (grey dotted line), but note that this scenario should be read with caution, as income was not significant in the multivariate model.

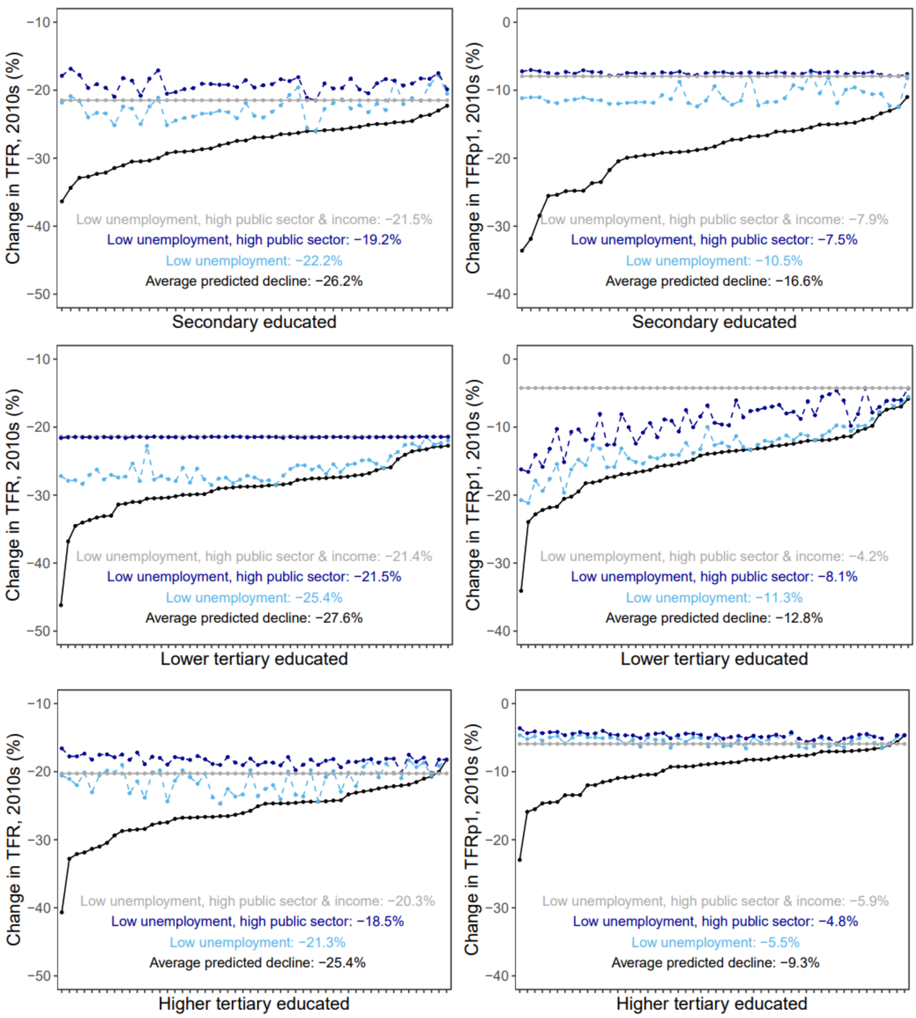

Figure 16 Predicted declines and counterfactual scenarios in the change in TFR (left-hand side) and TFRp1 (right-hand side) by field and level of education. The x-axis represents the detailed fields of education sorted by the strength of the predicted decline.

8 DISCUSSION

This study analysed recent fertility and family dynamics in Finland and the Nordic countries using aggregated data from the HFD and Nordic statistical agencies, individual-level register data from Statistics Finland and a variety of different methods and approaches. The focus was the Nordic countries because the period fertility decline that occurred in the 2010s was particularly pronounced there. The decline has surprised both researchers and policy makers because the Nordic countries have not previously been forced to address the implications of very low cohort fertility (below 1.75) faced by many European countries (Morgan 2003; Zeman et al. 2018). The Nordic countries are of particular interest in family demographic research because these countries enjoyed relatively high fertility until the first decade of the 21st century and have been seen as forerunners in demographic behaviour during many decades. The abrupt trend change in fertility has also emphasized the need to develop new forecasting approaches.

First, this study assessed age, parity, tempo, and quantum drivers of the decline in total fertility across the Nordic countries. Second, completed cohort fertility for Nordic women at childbearing age was forecast using existing methods and by developing a new forecasting approach that assesses potential recuperation patterns. Third, changes in union patterns were analysed, and their impact on the recent first birth decline was assessed. Finally, the study investigated the relationship between the fertility decline, fields of study and uncertainty within these fields.

8.1 SUMMARY OF THE MAIN RESULTS

8.1.1 AGE, PARITY, TEMPO, AND QUANTUM DRIVERS OF THE NORDIC PERIOD FERTILITY DECLINE

The long-term decrease in fertility rates among women below the age of 30 accelerated in the Nordic countries during 2010–2018, and the strongest age-specific declines were typically observed among women in their mid or late 20s. At the same time, the long-term increase in fertility rates among older women stagnated or even turned negative, as fertility rates declined for all age groups except the over 40s. This implies that the strong recuperation pattern previously seen in the Nordic countries is weakening: Nordic women at higher childbearing ages are not catching up on births to the same extent as previous generations. Despite the long-term trend in fertility postponement in the Nordic countries, Nordic completed fertility remained stable in the past because women caught up on postponed births at older ages (Andersson et al. 2009). Previous studies have highlighted the importance of welfare provisions and organizational features that support dual-earner parents and thereby promote fertility recuperation (Kravdal and Rindfuss 2008; Lesthaeghe 2010), but currently such measures do not appear to be hindering older age fertility declines in the Nordic countries.

When examining parity contributions to the decline in period fertility, the decline in first births explained most of the decrease in all Nordic countries: 57% in Iceland, 75% in Finland, 83 % in Norway, and close to or around 90% in Sweden and Denmark. The decline in first births was concentrated at ages below 30, but it was also notable at ages 30–35, which reflects a new trend of even later family formation postponement. Hence, compared to a few years ago, a larger share of women in their early 30s are currently childless. Without strong recuperation in first births at even older ages, ultimate childlessness will increase, and the childlessness plateau observed in the Nordic countries (Jalovaara et al. 2019) may be temporary. Additionally, almost no signs of fertility recuperation for any parity were observed in any of the countries. Instead, third-birth intensities declined strongly in Iceland, and second and third births declined to some extent in Finland and Norway. The first birth decline is in line with new findings from Finnish surveys that have identified a dramatic increase in childfree preferences in recent years: among childless women surveyed at age 25, around 21% of the 1990–1994 born cohort compared to around 4% of the 1975–79 born cohort reported their ideal number of children to be 0 (Savelieva et al. 2021). Pronounced increases were also noted when childless preferences were measured at older ages across different cohorts. Previously, childfree preferences were rare in Europe (Miettinen and Szalma 2014), and only recently has a rise in childfree preferences among younger people been reported in, for instance, the US (Hartnett and Gemmill 2020).

The lack of fertility recuperation at older ages and, instead, a new trend of declining older age fertility suggest that the recent decline in period fertility in the Nordic countries is not fully attributable to tempo effects – that is, to the postponement of births to older ages. This is also supported by tempo adjustments to total fertility that adjust for the distortion in the total fertility rate caused by the increasing mean age of childbearing. Although the increase in the mean age of first birth accelerated to some extent in Iceland, Norway, and Finland, the tempo- and parity- adjusted total fertility rates decreased, implying that the total fertility rate would also have decreased in the absence of fertility postponement. The gap between the TFR and the tempo- and parity-adjusted total fertility rate still highlights the tempo depressing effect: TFRs would be higher in the absence of fertility postponement.

8.1.2 COMPETED COHORT FERTILITY FORECASTS

The multiple forecasting approaches used in this study produce consistent forecasts: quantum changes are driving part of the decline, as completed cohort fertility is predicted to fall in all countries. Hence, the period fertility declines in the 2010s are different from the "roller-coaster fertility" (Hoem 2005) previously reported in Sweden around 1990, which had no implications for cohort fertility. However, the magnitude of the expected decline varies to some extent, both across methods and countries. Two patterns are emerging in the Nordic countries in terms of their predicted cohort fertility decline: Sweden and Denmark are on one trajectory with weaker declines, and it is still possible that cohort fertility could recover if fertility rates at older ages began to increase. However, Finland, Norway and Iceland are on another trajectory with strong predicted cohort fertility declines, even if older women began catching up on postponed births. The initial level was lower in Finland than in Norway and Iceland, and hence Finland is diverging from the other Nordic countries, as its cohort fertility is likely to fall well below the threshold of 1.75, which is considered the threshold for very low fertility (Zeman et al. 2018). The simple forecasts using the freeze rate approach show that the average completed cohort fertility level in the Nordic countries is predicted to fall from 2 children for 1970s cohorts to an all-time low of 1.8 children for late 1980s cohorts. If the negative trend were to continue, cohort fertility would fall even lower, as indicated by the 5-year extrapolation method (Myrskylä, Goldstein, and Cheng 2013) and the Bayesian method (Schmertmann et al. 2014). Given the declined intensities of first births at ages 30+, declining cohort fertility may be driven by both increasing childlessness and decreased family size.

Previous forecasts of cohort fertility in the Nordic countries suggested that cohort fertility would remain stable or even increase for Nordic women born in the 1970s (Myrskylä, Goldstein, and Cheng 2013; Schmertmann et al. 2014). However, these forecasts used data only until 2010, a period when older age fertility was increasing, and hence they extrapolated an increasing trend in older age fertility. In this study, there is only an overlap in the forecasts for women born in the late 1970s, and for most Nordic countries the point estimate places below the lower bound of the prediction intervals of the previous forecast, as, after 2010, the increasing trend in older age fertility reversed. In a recent evaluation of the performance of a large number of cohort fertility forecasting methods (Bohk-Ewald, Li, and Myrskylä 2018), the approaches developed by Myrskylä, Goldstein, and Cheng (2013) and Schmertmann et al. (2014) were ranked among the top performers. In the present study, utilization of these methods with updated data indicates that cohort fertility developments will be much less positive than previously thought, which highlights the challenges of forecasting in times of abrupt trend changes.

To overcome some of the limitations of the existing forecasting methods (e.g., strict modelling assumptions and consequently narrow confidence intervals) and to allow for reversals in the negative fertility trends at older age, a novel nonparametric approach was developed. The nonparametric approach provides the most likely recuperation paths based on historical data, but does not make assumptions about future trends. Using HFD data from the past four decades[5] – a period when the median pattern was increasing older age fertility – the nonparametric forecast yields the most optimistic scenarios of all the methods used. Nonetheless, Finland, Norway and Iceland would require stronger recuperation paths than ever seen in the historical data for cohort fertility to remain stable, while Denmark and Sweden would require paths in the top ranges of these data. The method employs a wide range of recuperation paths and yields large confidence intervals. Importantly, however, due to the lack of assumptions regarding smoothness over age and periods, some of the forecasted recuperation trajectories may be implausible in terms of patterns over age and time.

The confidence intervals of the forecasts – for example, future cohort fertility in Finland raging from around 1.45 to 1.75 – reflect the uncertainty of estimating the magnitude of future declines in cohort fertility. Although the direction in most Nordic countries is negative, the extent of the cohort fertility decline will depend on the conditions for having children in the near future. For instance, a weak economy, global crisis, or insufficient policies might push cohort fertility to the lower limit of the forecast intervals, whereas favourable conditions would possibly slow the decline to the upper limits of the intervals.

8.1.3 UNION PATTERNS AND THE DECLINE IN FIRST BIRTHS

The strong decline in first births in the Nordic countries raises the question of the extent to which changes in union patterns (e.g., decreased union formation or increased union dissolution) could explain the decline. As childbearing mainly occurs in unions (Kiernan 1999; Jalovaara and Fasang 2017), examining whether the fertility decline has occurred within unions or because the number of unions has decreased can help to pinpoint potential causes of fertility decline. In the case of Finland after 2010, there has been decreasing fertility in unions, long-term declines in marriage rates, and increasing dissolution rates among cohabiting couples. Lower childbearing in unions explains around three-quarters of the total decline in first births, and declining childbearing has been more pronounced in cohabitation than in marriage. Further, one-quarter of the total decline in first births is explained by changes

[5] The time periods used for the non-parametric method and the Bayesian method differ. The Bayesian method uses historical data as a source of priori information, which include fertility histories for cohorts born earlier than those appearing in the forecast surface.

in unions: lower marriage rates have been the most important, followed by higher dissolution rates and lower cohabitation formation. In general, the results are similar for both men and women. Comparing SES groups, the total decline in first births has been stronger among the less educated, but across all SES groups, declining childbearing in unions explains the largest part of the total decline in first births in all groups. Nevertheless, the decreased tendency to marry in cohabitation is more pronounced among the higher educated, whereas decreased cohabitation formation is stronger among the least educated.

In previous decades in Finland, first births increasingly occurred among cohabiting couples, and marriage increasingly took place after rather than before childbearing. However, since 2010, declining marriage rates have not been followed by increasing childbearing in cohabitation; rather, cohabiting couples are increasingly less likely to progress to either marriage or the first birth. The declining tendency to marry could reflect weaker commitment among couples, which then subsequently depresses childbearing, but as marriage and childbearing are closely related, the reverse is also possible: the lack of a first birth potentially leads to a decline in marriage. In this study, the latter case would reduce the contribution of changes in unions to the first birth decline and increase the importance of changes in childbearing within unions. The quality of cohabitation unions may also have changed in ways not possible to capture by register data, but as a sensitivity check we compared declines in first births in unions across different union durations (results shown in the original publication).

The declining first birth transitions at older ages suggest that ultimate childlessness will further increase. Here, what is most worthy of note is that future ultimate childlessness is likely to increase in unions, and to not only result from the absence of stable unions, given the sharp decline in childbearing within unions. Previously, ultimate childlessness in Finland was strongly linked to never partnering or to living short spells in unstable cohabitation (Jalovaara and Fasang 2017). The findings of this study suggest that all SES groups may witness increases in ultimate childlessness due, primarily, to declining childbearing in unions and, to a lesser extent, to greater union instability. The lower SES groups may additionally experience increased ultimate childlessness because of increasing difficulties in forming unions, given the more pronounced decline in cohabitation rates in this group.

Although the decrease in entering cohabitation did not explain much of the decline in first births in the total population, it is an interesting development that requires further investigation. The decline observed predominantly at young ages in the 2010s is a departure from the long-term stable trend previously observed in Finland. It remains to be seen whether this development reflects an increase in never-partnering or merely postponement of union formation. Previous research highlights the need to further investigate the increase in the availability of dating partners through online dating sites and its effect on stable union formation (Hiilamo 2020), which, based on this study, should focus especially on SES differences.

8.1.4 FERTILITY DECLINE BY FIELD OF EDUCATION

Calculating trends in the TFR and TFRp1 in the 2010s across 153 fields of education revealed pronounced variation in the strength of the fertility declines, especially in the case of first births. Fields with initially lower fertility levels, such as ICT, arts & humanities and general education, experienced stronger declines (around -40% in TFR and around -30% in TFRp1), while fields with initially higher fertility levels, such as health and teaching, experienced weaker declines (around -20% in TFR and -10% in TFRp1). Hence, evidence of diverging fertility patterns across fields of education was observed. Moreover, the study also observed relatively strong declines in natural sciences and engineering and relatively weak declines in agriculture.

The results from univariate regression models estimating the association between the strength of the fertility decline and the level of uncertainty within fields revealed that the strength of the fertility decline increased with higher unemployment levels, lower proportions of women working in the public sector, and lower income levels. Multivariate regression models including all three uncertainty measures showed that these measures combined explained one fourth of the variation in the decline in total fertility and two fifths in the decline in first births. Counterfactual analyses showed that low uncertainty would have reduced the TFR decline by 25% and the TFRp1 decline by 50%, with low unemployment typically reducing the declines the most, followed by a high share of women working in the public sector.

The results imply that educational fields characterized by stable job prospects have escaped the very strongest fertility declines witnessed elsewhere and that objective economic uncertainty, instead, has fuelled the fertility decline. However, it should be noted that the analyses are not causal, and other factors, such as changes in preferences and lifestyle factors, might also explain some of the differences. Nevertheless, the results are in line with findings from Sweden showing that the first birth decline has been strongest among those with a weaker labour market attachment and lower earnings (Ohlsson Wijk and Andersson 2022). Moreover, first births are increasingly postponed or foregone not only among those without a degree, but also among those with a degree but educated in fields characterized by higher economic uncertainty. Even before the onset of the decline, the Nordic countries were already experiencing increasing levels of ultimate childlessness among those with only a basic education, and the negative gradient in childlessness across educational level was turning positive (Jalovaara et al. 2019). The current findings provide further indications that social inequality in childbearing is growing in the Nordic countries. Together with perceived uncertainties, a changing labour market (e.g., increased globalization and automation) (Blossfeld and Mills 2005; Sutela, Pärnänen, and Keyriläinen 2019), weaker income growth among the lower paid (OECD 2020), and rising living costs (especially rents and house prices) (Eurostat 2022) may contribute to particular difficulty in realizing childbearing plans among those with more objective uncertain employment.

8.2 NEW FERTILITY ERA IN THE NORDIC COUNTRIES

The Nordic countries are currently experiencing a new situation with a predicted decline in cohort fertility. Nordic women are not only having children later in life; they are also bearing fewer children. These findings stress the importance of directing more attention to accelerated population aging in public policy planning in the Nordic countries. The previous period fertility decline that also led to a substantial decline in cohort fertility occurred in the 1960s, but this decline was primarily driven by decreases in third and higher order births (Ruokolainen and Notkola 2007). The current decline is likely also to be driven by decreased first-birth progressions. Different cultural, socioeconomic, and institutional factors affect different parity-specific trends (Zeman et al. 2018), and the decision-making process regarding the first birth is likely to be particularly distinct. An increasing share of young people in the Nordic countries hesitate to start a family despite favourable circumstances for childbearing (having a stable co-residing partner and good education and employment and living in a welfare state with generous family-policies). This pattern is different from many other European countries with very low fertility, such as Eastern European countries, where overall fertility is low but first birth progressions are high (Zeman et al. 2018).

It remains to be seen how cohort fertility develops in other relatively high fertility countries where period fertility also declined in the 2010s (e.g., France, Ireland, the United Kingdom, and the United States) (Human Fertility Database 2022). If cohort fertility also decreases in these countries, the Nordic countries (except for Finland) may still remain among the top fertility countries in Europe, albeit at lower levels than before. Up-to-date forecasts for other high-income countries are necessary to place the Nordic fertility declines in a broader perspective.

Recent data from the period 2020–2021, which was not covered in this study, suggest that the Nordic fertility decline of the 2010s came to an end shortly after 2019 (Human Fertility Database 2022; Official Statistics of Finland (OSF) 2022b; Statistics Iceland 2022; Statistics Norway 2022). Finland experienced the strongest recovery from a TFR of 1.35 in 2019 and 1.37 in 2020 to 1.46 in 2021, while Sweden merely experienced a modest slowdown in the fertility decline (the TFR was 1.71 in 2019 and 1.67 in 2020–

2021). A recovery of period fertility rates was expected and even predicted at some point as a consequence of a slowdown in fertility postponement (Nisén et al. 2020), but it rather surprisingly coincided with the covid-19 outbreak (Nisén et al. 2022; Lappegård et al. 2022). However, preliminary data from the beginning of 2022 suggest that birth rates may be declining again (Official Statistics of Finland (OSF) 2022c; Bujard and Andersson 2022).

8.3 NORDIC FERTILITY DECLINES IN LIGHT OF FAMILY DEMOGRAPHIC THEORIES

8.3.1 GENDER EQUALITY

A cohort fertility decline in the Nordic countries is interesting in itself, given that these countries' previously relatively high and stable cohort fertility is often attributed to generous social policies promoting work-family reconciliation. In demographic theories, the Nordic countries are frequently highlighted as illustrative examples of the critical importance of men's increasing participation in family life and stronger institutional support to prevent fertility declining to very low levels in high-income countries (Anderson and Kohler 2015; Esping-Andersen and Billari 2015; Goldscheider, Bernhardt, and Lappegård 2015). However, no signs have been detected of a drop in gender equality or a weakening of family policies (Rostgaard 2014; Duvander et al. 2019) that could explain the recent fertility declines according to these theories. Instead, the Nordic countries are becoming increasingly more gender equal in respect to child rearing, as, for instance, the length of the father's quota has risen in most Nordic countries, and cash-for-care payments were shortened (Norway) or abolished (Sweden) during the 2010s.

One might speculate that the strong decline in cohort fertility to low levels in Finland has emerged because this country is less active in promoting gender equality (the father's quota was introduced relatively late; the fathers' uptake of parental leave is low; the cash-for-care scheme is popular, and day-care enrolment for small children is low) (but see the family leave reform entering into force in 2022 Sarkkinen and Haatainen 2021). Fathers' involvement in childrearing is far less of a social norm in Finland, and Finland does not score highly on all measures of gender equality. Hence, Finland lags behind the other Nordic countries in this respect. Indeed, gender equality theories predict that fertility can be low when gender equality has not yet progressed sufficiently within the family. Lappegård and Kornstad (2020) demonstrated that, in a particular region, fathers' involvement, as measured by the proportion taking the father's quota, positively affected first and second births among women in that region – in regions with a low uptake of the quota, women might have more reservations about bearing children because mothers are expected to manage much of the childrearing and domestic tasks alone. In addition, the home care culture in Finland potentially contributes to the perceived incompatibility of bearing children with other life goals among childless young women. However, excluding Finland, the strength of the predicted cohort fertility decline does not correlate with the extent to which gender equality is implemented in policies in the Nordic countries, and it therefore requires alternative explanations. For instance, Norway has the longest father's quota, and Iceland has the most gender-equal parental leave scheme, but both these countries also observed strong declines in fertility in the 2010s. It might be suggested that other factors play an increasingly larger role in fertility behaviour in the Nordic countries.

Indeed, existing evidence indicates that the mechanisms underlying the Nordic fertility decline may go beyond the influence of family policies or developments in gender equality. First, the policy environment has generally been stable in the recent decade, as noted earlier. Second, the decline has mainly been driven by first births. Variation in first birth progression across high-income countries is typically smaller than in higher order births (Zeman et al. 2018), and hence, family policies may be of greater importance for higher order births than for first births. Third, both cohort ultimate childlessness (Jalovaara et al. 2019) increases and period first-birth trend decreases have been most pronounced among the least educated, who might benefit less from policies that help to combine work and family. Policies designed to reduce the opportunity cost of childbearing may be more important for higher educated women. However, the fact that the fertility decline is accounted for primarily by a reduction in first births rather than subsequent births still implies that gender equality is essential for mitigating fertility declines. Fathers' involvement (such as the use of the fathers' quota) in family life among parents promotes further childbearing in the couple (Duvander et al. 2019). It could be argued that the advancement in gender equality in the Nordic countries dampened (strong) declines in second and third births in the 2010s. The amount of domestic work is much lower among childless couples than among parents. Hence, the importance of sharing domestic tasks in the home might be more important for subsequent children than for the first birth, and other factors might be more important for the first birth (e.g., an uncertain life situation or competing interests and life goals). Alongside gender equality, cultural factors and economic and labour market uncertainty and are also important drivers of fertility.

8.3.2 SECOND DEMOGRAPHIC TRANSITION THEORY

Many of the changes in family demographic patterns witnessed since the 1960s in the Nordic countries and elsewhere – for instance, later and less childbearing and the rise in living arrangements other than marriage – have been explained by the second demographic transition theory, which emphasizes individual autonomy and self-actualization (Lesthaeghe 2014). The SDT originally predicted that new demographic behaviour would begin among the more highly educated and then eventually spread to the rest of the population (Lesthaeghe and Surkyn 1988), but contrary to these predictions, changes in union patterns and union-first births since 2010 in Finland have not typically been driven by the higher educated individuals. All educational groups have experienced strong declines in first births, which have been attributed primarily to decreased childbearing in unions rather than to changes in unions. If anything, the patterns have been more pronounced among the least educated, as has been the case for the total decline in first births and the drop in cohabitation formation. Notably, Finland already has a long history of individualistic values (Sobotka 2008), and these values had probably already spread from the higher social strata to the total population before the 2010s. Instead, the stronger declines in some patterns among the lower social strata point toward economic barriers or uncertainty. Interestingly, however, one SDT feature, voluntary childless, which was not widespread before 2010 but appears to have gained ground in Finland only in the last decade (Savelieva et al. 2021), may explain some of the fertility decline. The increase in voluntary childlessness is in line with the pronounced declines in first births observed in this study. Further, qualitative research from Finland highlights the prevalence of negative perceptions of family life among young people and their desire to pursue other life goals as increasingly important reasons for delaying childbearing in recent years (Rotkirch et al. 2017).

8.3.3 ECONOMIC CONSTRAINTS AND PERCEIVED UNCERTAINTY

Rising economic uncertainty has been proposed as a central driver of the recent fertility decline in the Nordic countries and elsewhere in Europe (Comolli et al. 2020; Vignoli, Guetto, et al. 2020). Scholars argue that, with the spread of globalization and new technological channels (e.g., social media) observed particularly in the 2010s, the future has become less predictable, which adds an additional source of economic uncertainty with consequences for fertility dynamics. Therefore, individuals may act according to or despite their own economic situation based on their expectations and perceptions of the future, which are shaped by both past experiences and the social context (e.g., shared narratives from peers, the media, and others) in which they live. The patterns in unions and in first childbearing observed in Finland are in line, to some extent, with this Narrative Framework. First, most of the decline in first births are explained by declining first birth progressions in unions rather than decreased cohabitation rates. Cohabitation is considered more compatible with uncertainties, given that it is a less permanent and irreversible life decision than childbearing or marriage (Guetto, Vignoli, and Bazzani 2020). Second, the patterns are rather similar across SES groups. As the Narrative Framework suggests that individuals act according to their narrative for the future, which is not necessarily dependent of their own current situation, similar fertility patterns across groups can occur. This is also supported by Finnish surveys finding that perceived uncertainty was among the main self-reported reason to postpone (or forgo) childbearing in the 2010s, irrespective of socioeconomic background (Savelieva, Jokela, and Rotkirch 2021). However, the fact that the present study observed more pronounced first birth declines in the lowest SES group and in educational fields with higher objective labour market and economic uncertainty suggests that, in addition to perceived uncertainty, actual economic constraints are also relevant for the recent changes.

8.4 STRENGTHS AND WEAKNESSES

The core strength of this study is that it examines the rapid fertility decline in the 2010s in the Nordic countries from many different angles with a variety of methods. The study also developed a new method and applied and modified existing approaches used elsewhere in studying fertility change. The tempo-adjustments and the cohort fertility forecasting methods examined the tempo and quantum changes in fertility in the 2010s from different angles, and thus the results are not based on single assumptions. The various forecasting methods were further based on different assumptions and allowed for various scenarios in fertility behaviour. Sub-study I developed and used a novel non-parametric forecasting approach to estimate future cohort fertility. This method was useful for estimating completed cohort fertility levels in a scenario where older-age fertility begins to increase again after the sudden trend change observed in the 2010s. The Nordic countries have a history of strong recuperation patterns (Andersson et al. 2009), but the best-preforming existing cohort fertility forecasting approaches contain strict modelling assumptions and generally do not predict trend changes, and/or produce fertility developments that lead to unusual shapes in time series or cohort schedules (Bohk-Ewald, Li, and Myrskylä 2018). The new non-parametric approach is not restricted to certain model assumptions and produces therefore relatively large prediction intervals – prediction intervals that for most Nordic countries do not include a stable development in cohort fertility – which increases the confidence that future cohort fertility is unlikely to remain stable.

Another strength of the study is the utilization of cohabitation information in sub-study III, which is rare even in the Nordic context. Moreover, sub-study IV adopted an approach that identified groups of educational fields from individual-level data and further used them in an aggregate analysis as units in regression models. The strength of this approach is its ability produce fertility estimates over time for many fields. However, individual level analysis would have allowed for the inclusion of more information (e.g., the partner's characteristics) but would, then again, have required the exclusion of single individuals. The strength of this study is also its use of population data covering the entire population of each Nordic country.

In the analysis in sub-studies III and IV of Finland, however, only individuals born in Finland were included. This was to overcome the limitation of incomplete education (and potentially also childbearing) histories among individuals born abroad; nonetheless, this led to lost information for immigrants. However, the sensitivity analysis preformed in sub-study III showed that immigrants exhibited rather similar union-first birth patterns to those of native Finns. The decline in total fertility was somewhat steeper among the native population: the total fertility rate fell in 2010–2020 from 2.1 to 1.75 (17%) for women with a foreign background who were born abroad, from 1.95 to 1.51 (23%) for Swedish-speaking Finns, and from 1.85 to 1.32 (29%) for Finnish-speaking Finns (Official Statistics of Finland (OSF) 2021c, 2022a). It would be especially interesting to disentangle future cohort fertility patterns and age and parity drivers of the 2010s fertility decline by immigrant background in a country like Sweden, with relatively high proportions of foreign-born individuals (Vasileva 2011), but that is beyond the scope of this study. However, a recent study showed that the first birth decline in Sweden in the 2010s was rather similar across population groups, including those with an immigrant background (Ohlsson Wijk and Andersson 2022).

Sub-study III applied a multistate model and a counterfactual approach to study the contribution of changes in unions versus changes in childbearing within unions in explaining first birth declines. The multistate model is rather simple, and the probability of each transition depends only on the state attained in the previous step and not on the full history of event, which is a potential limitation, as it might omit some information. However, the sensitivity analysis in sub-study III revealed that first births declined in all unions regardless of union length.

8.5 CONCLUSION

The Nordic countries witnessed strong fertility declines in the 2010s — a decline that is neither straightforwardly related to structural factors like business cycles (Comolli et al. 2020) or changes in social policies nor fully explained by accelerating fertility postponement. The decline most likely reflects declining fertility quantum, as the Nordic countries' cohort fertility is forecast to decline notably for the first time in three decades. New theories linking improvements in gender equality with higher fertility did not predict this decline; rather, they commonly use the Nordic setting with relatively high fertility, high female-labour force participation and increased participation in the home by men as an illustrative example of the theory. The results indicate the need to update the Nordic model of high and stable fertility; moreover, they demonstrate that Finland, with its lower predicted fertility levels, is diverging from the other Nordic countries.

The recent fertility decline is more strongly concentrated among childless couples than among parents. Whereas, in the past, couples pondered the timing of childbearing and the number of children they would raise (and succeeded relatively well in realizing their childbearing plans due to the generous Nordic family policies), an increasing share of couples now hesitate to have children at all. Family policies consisting of parental leave, day care, and child benefits might be insufficient to support these couples in starting a family. In today's Nordic countries, beginning a family is rarely prevented by career plans; rather, it is increasingly hindered by a (perceived) uncertain life situation. Childfree ideals are rising in Finland, but less is known about changing childbearing plans in other Nordic countries. Increasing uncertainty or cultural factors may have become more important than the development in gender equality in explaining fertility change – and particularly in explaining the change in first births. To understand the changing fertility patterns in the developed world, further studies should more closely investigate why young couples in the Nordic countries hesitate to start a family despite favourable conditions. Future studies should pay particular attention to uncertainty caused by other factors than those related to employment, such as concern about climate change, an issue raised by the media but not yet extensively studied in fertility research (but see Alakärppä, Sevón, and Rönkä 2020). With major causes of uncertainty emerging after the 2010s – rapidly increasing awareness of climate change, the outbreak of the covid-19 pandemic, and Russia's invasion of Ukraine, overall uncertainty is increasing and may exert even greater influence on fertility decision-making. Non-register data, such as survey data and qualitative interviews that include childbearing preferences, personal perceptions, and different aspects of perceived uncertainties, would be highly valuable in gaining further understanding about the recent fertility decline.

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