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Abstract: Systematic comparisons of fertility developments based on education, gender and country context are rare. Using harmonized register data, we compare cohort total fertility (CTF) and ultimate childlessness by gender and educational attainment for cohorts born beginning in 1940 in four Nordic countries. CTF has remained fairly stable in all countries. Childlessness, which had been increasing, has plateaued except in Finland. Women's negative educational gradient has vanished, while men's positive gradient has persisted. The highest level of men's childlessness appears among the less educated, revealing striking educational differences. Childlessness has increased among low-educated women but not among highly educated women. The educational gradient in women's childlessness has shifted from positive to negative. Thus, we witness both a new gender similarity and widening social inequalities in childbearing in the Nordic welfare states. Low-educated citizens of both sexes have apparently become an increasingly marginalized segment with regard to childbearing.

Key words: cohort fertility, education, gender, Denmark, Finland, Norway, Sweden

Introduction

Over the past 60 years, European countries have experienced a remarkable expansion of education at the upper-secondary and tertiary levels. The proportion of persons lacking degrees beyond the basic level has halved within one generation. In 2015, only 15 percent of 25–34-year-olds in Europe (EU 22) were without post-basic education compared to 30 percent of 55–64-year-olds (OECD 2016, Table A1.3). This change has been particularly pronounced among women. In almost all post-industrial societies, young women now outnumber men in attaining tertiary degrees (Vincent-Lancrin 2008; Lutz et al. 2008; Charles 2011).

A vast array of literature has documented the fundamental role of educational attainment in shaping women's childbearing patterns, especially their timing of births and their childlessness. The findings generally reveal that highly educated women tend to have their first child at an older age and that their levels of childlessness are higher than those of less educated women (for reviews, see Hoem et al. 2006; Tanturri et al. 2015; Nitsche et al. 2015).

Little is known about whether and how the associations between women's increasing educational attainments and their ultimate fertility have changed over time (van Bavel 2012; Tanturri et al. 2015). Recent studies suggest that educational expansion has had only limited effects on childlessness patterns by educational level in continental European countries (Beaujouan et al. 2016). In most European countries, highly educated women are still more likely to remain childless than low-educated women (Wood et al. 2014; Miettinen et al. 2015; Tanturri et al. 2015).

Compared to research on women's fertility, research on the fertility of men is scarce and almost uniformly suggest a positive association between men's educational attainment and their fertility outcomes (Trimarchi and van Bavel 2017; Tanturri et al. 2015; Miettinen et al. 2015; Nisén 2016). However, almost no research has addressed the ways in which increases in educational attainment and the reversal of the gender gap in education to women's advantage are related to changes in men's fertility outcomes.

When women regularly attain educational levels that are similar to or higher than those of men and economic and social roles become more similar, gender differences associated with education and fertility would also be expected to diminish. Studies examining the timing of entry into motherhood and fatherhood in France and women's and men's fertility postponement and childlessness in Britain have resulted in some support for this 'convergence hypothesis' (Winkler-Dworak and Toulemon 2007; Kneale and Joshi 2008). Whether the gendered patterns in fertility have also converged in other countries is an open question. The determination of whether differences in women's and men's fertility would converge within educational groups only or whether educational differences in fertility outcomes would also diminish is also unclear. In the first case, we find 'convergence across gender lines' while educational differences persist; in the latter case, we find 'convergence

across educational lines’ and consequently diminishing differences in fertility outcomes between educational segments of both women and men.

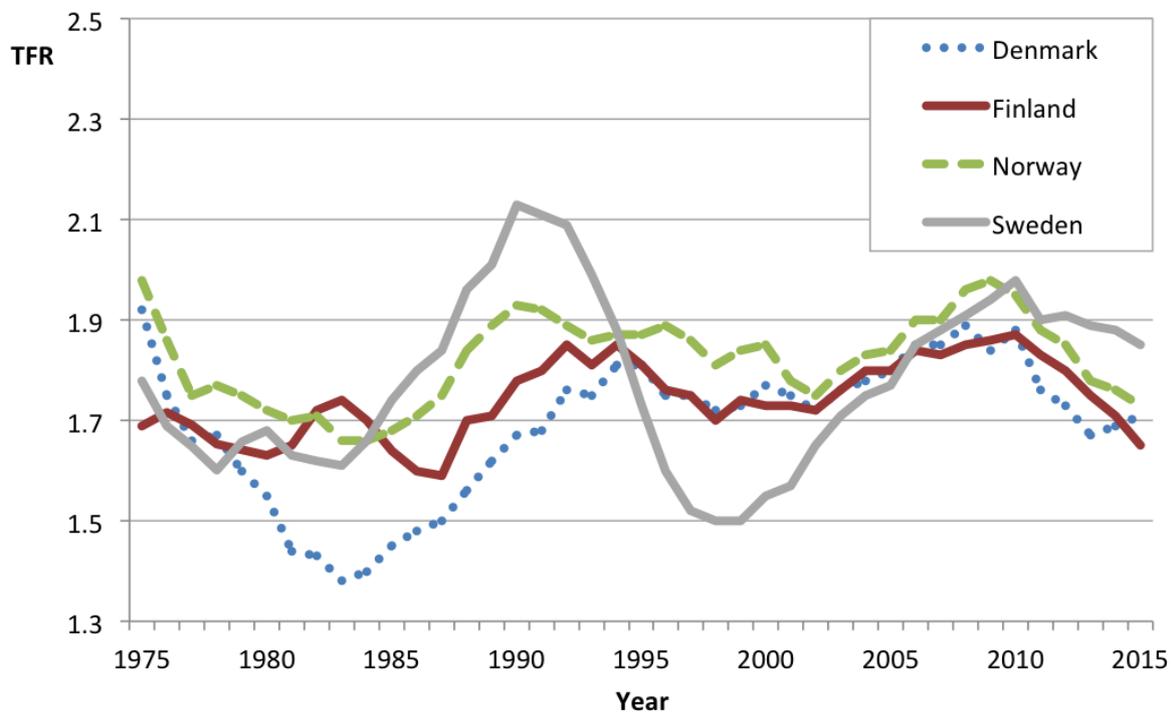
This study examines the ‘convergence hypothesis’ in greater detail by differentiating between ‘convergence across gender lines’ and ‘convergence across educational lines’ in cohorts born since the 1940s in the Nordic countries. The Nordic welfare states are often considered to be forerunners in developing both social and gender equality. Therefore, when researching the ways in which gendered associations between education and fertility have developed over time, the Nordic countries may establish a blueprint for similar changes in other post-industrial societies. In the Nordic countries, the aim of social equality is the reduction of differences between social strata (here represented by the level of education). The aim of gender equality is the equal participation of women and men in paid work, family care work, and society at large. Considering both core aims, equality is generally understood as ‘equality of outcome’ (Phillips 1999). Thus, the Nordic countries have been forerunners in Western Europe in promoting formal education and in implementing policies that reduce the opportunity costs of family formation and support both sexes’ participation in paid employment and childrearing. Given these aims and policies, we might expect negligible, if any, differences in fertility patterns between educational groups, between men and women, and between the Nordic countries. Indeed, previous research suggests that unlike many other societies, educational differences in women’s completed cohort fertility in the Nordic countries have diminished over time (Andersson et al. 2009; Miettinen et al. 2015).

Our study compares ultimate fertility by gender and educational attainment for cohorts born in 1940–1967/69 for men and 1940–1972/74 for women in four Nordic countries: Denmark, Finland, Norway, and Sweden. In other words, we compare fertility differentials between a) birth cohorts, b) men and women, c) educational segments, and d) four Nordic countries. This allows us to follow the change in fertility patterns across educational and gender lines and to draw conclusions about the potential forces behind these developments.

This analysis focuses on two aspects of ultimate fertility: completed cohort fertility, or Cohort Total Fertility (CTF, mean ultimate number of children), and the levels of ultimate childlessness, measured at age 45 for men and age 40 for women. We harmonize longitudinal individual-level data drawn from the national population registers of the Nordic countries and use a straightforward cross-sectional approach of measuring education simultaneously with ultimate fertility (age 45 or 40).

We adopt a cohort approach. Period measures such as the period Total Fertility Rate (TFR) are otherwise common in fertility research and official statistics. They mainly provide information on short-term changes in fertility behavior. As a background, Figure 1 shows the development of TFRs in the four Nordic countries during 1975–2015. The TFRs of each country show similar developments, though with stronger fluctuations in Sweden than the other countries (see Andersson 2000). These data stem from official statistics. As is often the case, they are based on the age-specific fertility rates of women.

FIGURE 1: Period Total Fertility Rate (TFR) of women in the Nordic countries, 1975–2015.



Source: Nordic statistical central bureaus

Our empirical analysis begins with an overview of the development of CTF and childlessness among men and women in each Nordic country. Then, we summarize the developments in educational attainment. Finally, the analysis focuses on the developments of educational differences in CTF and ultimate childlessness across cohorts, comparing women and men within and between the four countries. Before moving on to the data and empirical analysis, we give a condensed overview of prevalent theoretical perspectives on the relevant associations.

The association between education and fertility – modified by gender, institutional context, and educational expansion?

Three theoretical approaches lend themselves particularly well to investigating how educational expansion and social change relate to fertility convergence across gender and educational lines: economic, gender-equity, and institutional aspects. Microeconomic theories of fertility suggest that higher levels of socioeconomic resources positively influence couples' childbearing but that this influence is also gendered with men's resources having a more consistently positive effect (Becker 1993). In principle, both women and men contribute to the household's economic resources, and greater resources add to the ability of the family to invest in having and raising children – referred to as the 'income effect'. However, an opposing force ostensibly influences women: motherhood obligations lead to limitations in

career opportunities and losses in work earnings, referred to as the opportunity costs of motherhood. Owing to their greater earnings potential, highly educated women are assumed to have higher opportunity costs and thus lower probabilities of childbearing than low-educated women. However, these arguments clearly rest on the assumption that women are the only or primary caregivers of their children and that they interrupt their employment to rear their children. By contrast, men are viewed as the main economic providers in a family, and fatherhood is not seen as conflicting with men's employment and career; highly educated men are assumed to have higher fertility than low-educated men due to their greater capability to secure a sufficient living standard for their family.

Several scholars argue that these gendered associations are weakening or even reversing. This is mostly attributed to changing gender relations in the public and private spheres (McDonald 2000; Esping-Andersen and Billari 2015; Goldscheider et al. 2015; Anderson and Kohler 2015). Theories on gender and fertility development have suggested a decline in fertility with women's rising participation in education and employment, which would make women dually burdened with paid work and care of their families. Scholars further argue that if men take more caring responsibilities and share family work more equally with their partners, fertility levels may be maintained or even increase (McDonald 2000; Esping-Andersen and Billari 2015; Goldscheider et al. 2015; Anderson and Kohler 2015). All of these theories imply that greater gender equity within the family will have the strongest fertility-promoting effect among highly educated women because of their greater opportunity costs when their involvement in paid work is restricted.

Institutional approaches to fertility focus on the role that institutions and welfare states play in retaining or modifying gender, social, or economic relationships in society and in the family (Neyer 2003). These approaches assume that the institutional context shapes the links between gender, education and fertility (Neyer et al. 2017). Social policies in the Nordic countries have often focused on supporting social and gender equality in areas relevant for family life. For example, the affordable and high-quality childcare that is available in the Nordic countries helps each parent in reconciling employment and childrearing and therefore reduces the opportunity costs of having a(nother) child. A positive role may also be played by parental leave policies that support the gender-equal division of care, facilitate the combination of work and care for both parents, and substitute reductions in work earnings through earnings-based benefits during family leaves. Gender- and social-equality measures incorporated into labor market and welfare policies may prevent direct or indirect disadvantages in terms of employment and career that result from parenthood. In the Nordic countries, these policies and measures have been in place since the late 1960s in order to increase women's participation in the labor market, promote men's participation in family work and care, and establish a society with gender equality. These policies are considered important factors in maintaining high fertility in the Nordic countries (Andersson et al. 2009).

In addition to educational expansion and the reversal of the gender gap in education, the labor force participation of women has also increased, and their economic position has strengthened in society as well as in families. The relative contributions of partnered women

and men to family incomes have changed; an increasing portion of partnered women have similar or higher education and earnings than their partner (Klesment and van Bavel 2017; Mäenpää and Jalovaara 2015). The Nordic countries have been at the forefront of these developments. In the two-earner family model that now prevails in the Nordic countries, women and men are more similar than before in their economic and domestic roles, and both partners' earnings are considered essential for the economic security of the family.

Taken together, developments in the private and public sphere lead us to suspect that in contemporary Nordic countries, women's high education is no longer as much at odds with childbearing as it used to be and as conventional economic theories suggest. Theories on the relationship between education and fertility in post-industrial societies mainly concern the opportunity costs that discourage childbearing, particularly among highly educated women. However, as argued above, these opportunity costs may be less important in societies such as the Nordic ones in which the two-earner family model prevails and where women are able to combine childbearing and paid employment with relative ease. The opposing income effect could then be expected to gain in relative importance among women: having sufficient economic resources to sustain a family would promote childbearing not only among men but also among women (Andersson 2000). Therefore, attention should be directed toward obstacles to childbearing among the low educated for both sexes. Unemployment risks are higher and earnings are lower among low-educated men and women, creating labor market insecurities that may create barriers to childbearing. Given that low-educated women are most likely to partner with low-educated men, these insecurities may accumulate in couples. Additionally, the lowest educated have the lowest likelihood of forming a union at all and have the lowest union stability. Therefore, the shorter time spent in stable partnerships is a factor that further links low education to reduced fertility (Trimarchi and van Bavel 2017). Moreover, the expansion of education may have aggravated the fertility-depressing conditions for lower educated women and men. With the general increase in education, the low educated have been crowded out of many segments of the labor market (Gautier et al. 2002; Albrecht et al. 2009). This process was intensified by the restructuring of economies from industrial to high-skilled post-industrial activities. These developments suggest that having children may have become more difficult for the low educated regardless of gender. In other words, we expect that the inverse association between women's education and fertility has attenuated with the lower educated facing increasing obstacles to childbearing.

Data and methods

Our analyses are based on individual-level data drawn from population registers and from the registers of educational degrees of each Nordic country. The Nordic countries have a long history of full and reliable registration of their resident populations and their vital events. Residents of the Nordic countries have a unique personal identification number, which enables an accurate, computerized linking of information from different data sources. Our data cover the entire population of Denmark, Norway and Sweden as well as an 11 percent sample of the population of Finland.

We follow the logic of a true cohort design. We focus on women and men who were born in their respective country and who were alive and resided in that country at age 40 for women and age 45 for men. Age is measured at the end of each calendar year. Return migrants, i.e., persons who were born in the respective country, emigrated and had returned by age 40 (women) or 45 (men), are included in the analysis.

The analysis covers cohorts born from 1940 to 1974. We have complete cohort data for all individuals born in 1940–44 up to the 1960–64 five-year cohort. For the youngest cohorts (1965–74), the study populations vary by country and by sex due to the different age limits for women and men and the last year for which data are available. For women born in 1965–69 we have complete data for all four countries. For those born in 1970 onwards, we have a five-year cohort coverage (1970–74) for Denmark and Norway and a three-year cohort coverage (1970–72) for Finland and Sweden. Likewise, for men born in 1965–69, our study comprises complete five-year cohorts for Denmark and Norway and three-year cohorts for Finland and Sweden.¹

The two outcomes of our study, completed cohort fertility and ultimate childlessness, are based on the dates of all recorded childbearing events (live births). Births to return migrants while they were abroad are also included, although some missingness (e.g., if the child remained or died abroad) may have occurred. Unlike in survey data on men in which births in previous unions and non-marital births in particular often go unreported (Rendall et al. 1999), the registers cover men's childbearing histories nearly as completely as those of women. Nevertheless, some slight proportion of the lower cohort fertility and higher childlessness among men than among women likely reflect the fact that fatherhood is sometimes not registered.

We measure cohort total fertility and childlessness at age 45 for men and 40 for women. A very small portion of women and men have additional children beyond those ages, but choosing higher age limits would lead to the exclusion of the most recent cohorts and thus limit our opportunities to assess the latest trends in completed fertility and ultimate childlessness.

In our study, we measure education at the same age as ultimate fertility and childlessness are measured, that is, at age 40 for women and 45 for men. We chose this approach because it was simple and direct.² To achieve maximum comparability across countries, we harmonized

¹ Comparative analyses between three- and five-year cohorts for Denmark and Norway showed no differences in results, so we expect that neither our comparison over time nor across countries is distorted by having only three-year cohorts for the most recent birth cohorts of Finland and Sweden.

² Education and childbearing are commonly known to be two interacting processes: education affects childbearing, but childbearing, especially at an early age, may affect further education. Results on the association between education and fertility are sensitive to when (at what age) and how education is measured (Hoem and Kreyenfeld 2006; Kravdal 2004), and the same applies to different methods of analysis to measure fertility outcomes. Our approach differs somewhat from that used by Andersson et al. (2009), which focused on women's cohort fertility in the Nordic countries. In that study, education was measured at age 30 and a prospective study design was applied. In the Nordic countries, movements in and out of education occur frequently, and many people become parents prior to finishing their highest level of education (Hoem et al. 2006; Tesching 2012). Therefore, determining the ideal age to measure education is difficult. We explored

the definitions of educational level attained using the 1997 International Standard Classification of Education. The groups are:

Low education (primary and lower secondary)	ISCED 0–2
Medium education (upper secondary)	ISCED 3–4
High education (tertiary)	ISCED 5–6

We excluded data on the very few cases with missing information on educational attainment. The exception is Finland, whose data do not allow us to distinguish persons with missing educational information from those with the lowest educational level. Although the data were maximally harmonized, the country comparisons may be somewhat hampered by differences and changes in educational systems, educational codings and classification procedures. However, the comparisons benefit from the fact that the Nordic educational systems are fairly similar and that most data differences do not affect the comparability of trends. For Norway, we use a revised classification of education that was made to improve international comparability (Statistics Norway 2017). We present our results as figure diagrams, but all results are available as tables on request from the first author.

Results

Fertility developments: Cohort Total Fertility

Figure 2 shows the development of Cohort Total Fertility for men and women in each Nordic country. CTF has remained remarkably stable in all countries, especially when compared to the TFR of the period (Figure 1). In Denmark and Norway, cohort fertility fell slightly among the oldest, pre-1950s cohorts, and plateaued thereafter. The CTFs of Finland and Sweden have been at almost the same levels across all cohorts.

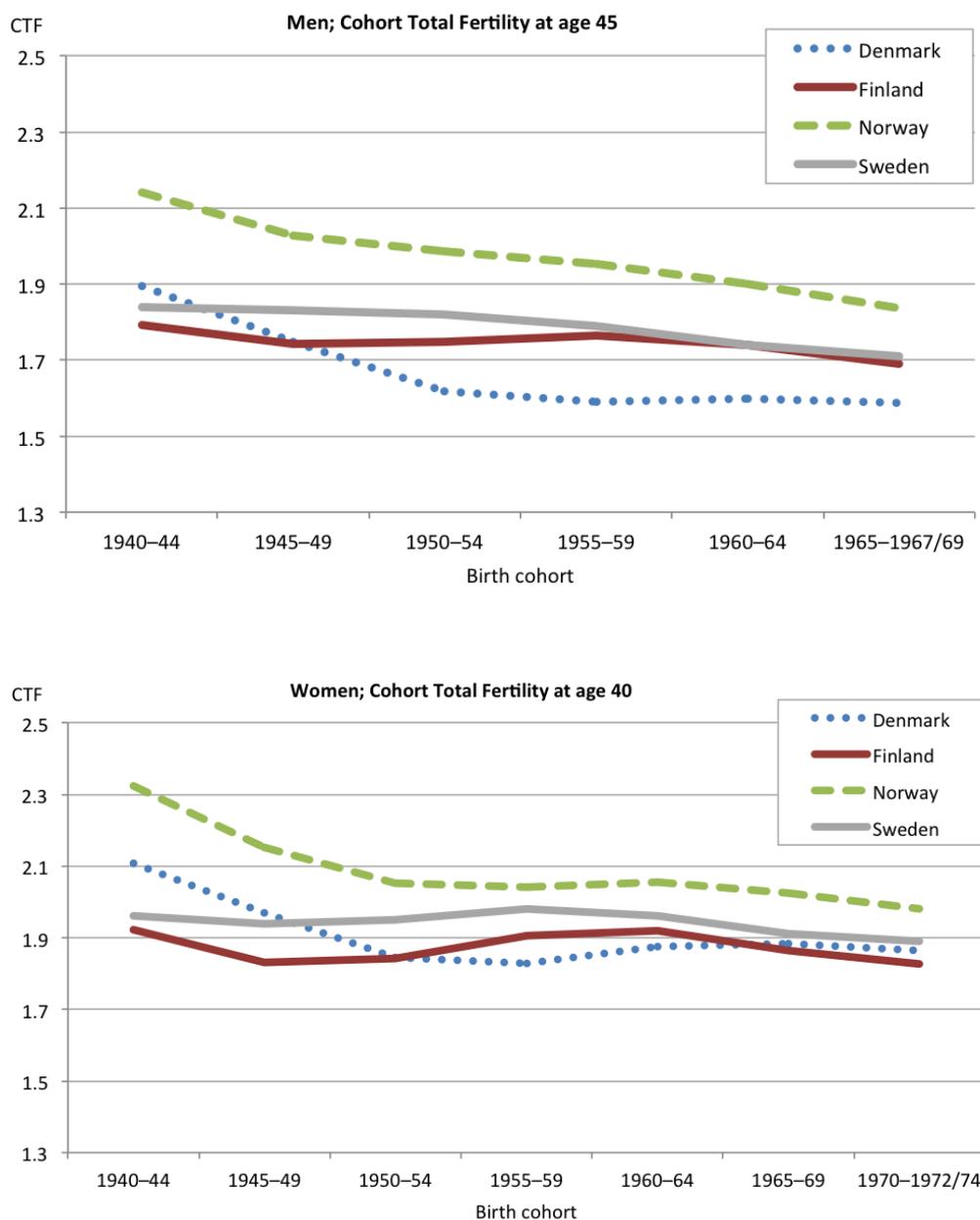
Female CTFs are consistently close to the replacement level in all countries and cohorts. Neither the ‘lowest-low’ period-TFRs of Denmark (in 1983) and Sweden (in 1998–1999) nor the ‘roller-coaster’ of fertility (Hoem 1990; 1993; Andersson 2000), which all Nordic countries experienced to some extent (see Figure 1), had a resounding effect on CTF. This is partly because cohort fertility is more robust to changes in the timing of childbearing; it also reflects a recuperation of fertility at older ages. In the Nordic countries, the younger cohorts have their children at older ages, but on average, they have as many children as the cohorts born two to three decades earlier (Andersson et al. 2009). Differences between countries in women’s completed cohort fertility are small, and even further convergence of the CTFs has occurred among the most recent female cohorts.

In all countries, men’s completed fertility is somewhat lower than women’s, stemming from the fact that male birth cohorts are slightly larger than female birth cohorts and that each

alternative possibilities. Some cases resulted in minor differences compared to our study design and to the previous study by Andersson et al. (2009). Since the differences did not substantially affect the overall results and their interpretation, we settled for measuring educational attainment at the age when we measure fertility.

registered childbirth involves one man and one woman. Among all cohorts of men born since the 1950s, Danish men have had the lowest CTF (1.6). This value has been close to the level that demographers regard as the threshold between low and lowest-low fertility for women (1.5, see Billari and Kohler 2004). As with women, Norwegian men have had the highest completed fertility. Finland and Sweden fall between Denmark and Norway.

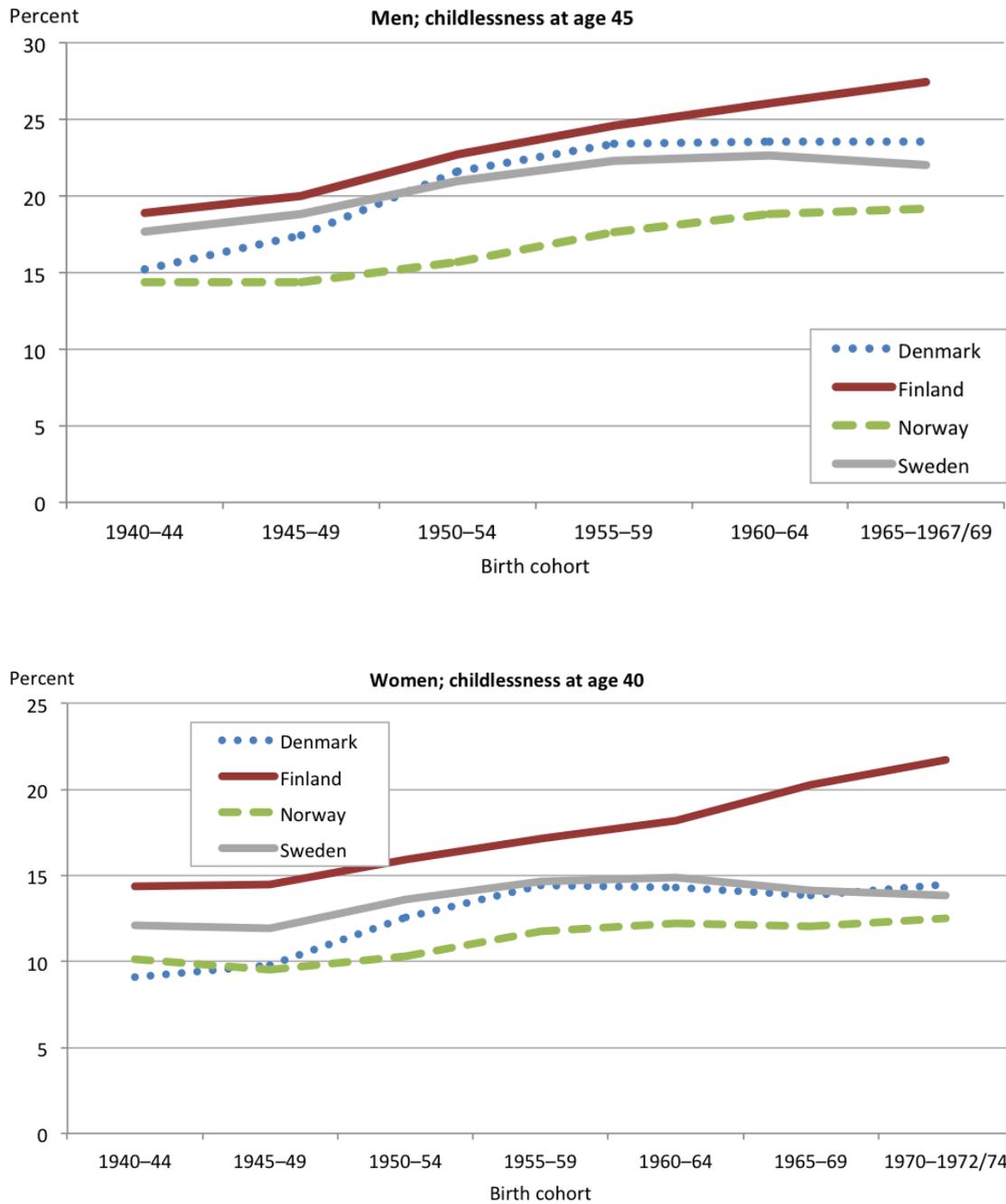
FIGURE 2: Cohort Total Fertility for men (at age 45) and women (at age 40) in five-year cohorts born in each Nordic country, 1940–.



Source: Nordic register data, authors' own calculation

Fertility developments: Ultimate childlessness

FIGURE 3: Childlessness (%) for men (at age 45) and women (at age 40) in five-year cohorts born in each Nordic country, 1940–.



Source: Nordic register data, authors' own calculation

Figure 3 shows the cohort development of ultimate childlessness for men and women in each Nordic country. Compared to CTF, childlessness exhibits major differences between cohorts, between sexes, and between the countries. Ultimate childlessness has increased in all countries when compared to the level of the 1940s cohorts. However, in most countries and as far as women are concerned, the increase has been very moderate; it has plateaued with the most recent cohorts, and childlessness has even decreased slightly. Moreover, a small part of the observed increase in ultimate childlessness may be compensated by unobserved increases in childbearing beyond ages 40/45. The trend reversals in later cohorts with stabilizing or slightly declining levels of childlessness in Denmark, Norway, and Sweden, is not (yet) observable in Finland, where childlessness levels in the youngest cohorts are quite substantial: 27 percent for men and 21 percent for women (see also Sobotka 2017). Since cohort fertility has remained rather stable in Finland, the increase in childlessness has been counterbalanced by a simultaneous increase in higher-order childbearing. Norway had the lowest levels of childlessness across all cohorts of women and men, including the most recent one, with only 12 percent childless women and 19 percent childless men. Overall, the gender difference in ultimate childlessness amounts to some 6–10 percentage points.

Developments in educational attainment

To provide background for assessing educational differentials in fertility development, we briefly describe the educational developments in each country. Figure 4 presents the percentages of men and women who have completed low (basic), medium (secondary), or high (tertiary) education as their highest educational level by cohort in each country.

<Figure 4>

Among men, the portion of low educated has decreased across the study cohorts in all countries but most strongly in Finland and Sweden (-32 and -26 percentage points, respectively). In both countries, this has been paralleled by increases of almost similar magnitudes in the portion of men with medium educational attainment. In the other two countries, the percentage of men with medium education has only risen slightly (Denmark) or not at all (Norway). The increases in high educational attainment among men are rather modest (+ 8 to 9 percentage points) or, in Sweden, hardly existent (+ 2 percentage points).

Among women, the changes across cohorts have been stronger. The percentages of women with only a basic education have dropped markedly (22–42 percentage points). Among the oldest female cohorts, 36 to 51 percent of all women had only basic education; among the most recent cohort, the percentages varied between 6 and 13 (men: 11 to 21 percent). Medium educational attainment increased (except in Norway) with initial increases followed by slight decreases. In all countries, the share of women with high education has risen sharply. Between 43 and 55 percent of women born in the early 1970s held a tertiary educational degree compared to 16 to 21 percent of women born in 1940–44. As in many other European countries, women’s educational attainment exceeds that of men – the share of tertiary education in our youngest cohort of men is 22 to 34 percent.

In sum, the low educated have become the smallest segment in both sexes. Women have clearly trended towards acquiring tertiary education, whereas among men, increases in tertiary education have been moderate, and medium education remains their most prevalent educational level by far. In older cohorts, men held higher educational degrees than women, but the secular developments have led to a reversal of the gender gap in education at both ends. In recent cohorts, the percentage of low educated is higher among men than among women, and the percentage of high educated is higher among women.

Educational differences in Cohort Total Fertility

<Figure 5>

Given the development of women's and men's educational attainment across cohorts, we examine whether concurrent changes can be discerned in cohort fertility based on educational segments. Figure 5 shows the development of educational differences in completed cohort fertility for women and men. Differences in cohort fertility by educational level are small in all Nordic countries, and patterns and developments are similar.

Across the male cohorts (Figure 5a), CTF declined in all educational groups in all countries, although not to the same extent. Some decreases are negligible. These decreases differ from the stability in cohort fertility that we observed for the aggregate group of all men taken together (Figure 2). These differences in trend developments are produced by compositional changes in which increasing fractions of men have received higher education. The CTF of low-educated men has consistently been the lowest. This holds across all countries and all cohorts. In Denmark and Norway, the difference between low-educated men and other educational groups of men has widened somewhat.

Female cohorts reveal a different gradient and development (Figure 5b). The older cohorts in all countries display a pattern that is commonly reported in the literature: The lowest educated women had the highest completed fertility, and the highly educated women had the lowest. However, this pattern has almost completely vanished in the youngest cohorts. In Denmark, Norway, and Sweden, a remarkable convergence of CTF levels has occurred across cohorts; the differences between educational segments have practically disappeared. This is due to stronger declines in CTF among low-educated women and increases (Denmark) or stabilization (Norway and Sweden) among the higher educated women. The Finnish pattern is different, where CTF has remained relatively stable across cohorts in all educational segments, and ultimate fertility is lowest among the highly educated and highest among the low educated also in the youngest cohorts of women. However, the differences are quite small, amounting to approximately 0.1 CTF unit per educational category.

A consequence of the main trends among men and women is that the gender gap in CTF by educational level has changed. Low-educated women of the older cohorts had the highest completed fertility, while low-educated men have had the lowest fertility in all cohorts. The decreasing fertility across cohorts among low-educated women led to the disappearance of

strong gender differential patterns in all countries except Finland. Low-educated men still have a lower CTF than any other group, but low-educated women no longer stand out with elevated fertility.

Educational differences in ultimate childlessness

<Figure 6>

In the previous sections, we observed that patterns and gradients in ultimate childlessness differed from those in ultimate fertility. Next, we present the developments of ultimate childlessness by educational attainment for women and men in the four Nordic countries (Figure 6). Note that owing to lower childlessness levels among women than among men, we use different y-scales in Figure 6a for men and Figure 6b for women.

Men present remarkable differences in childlessness levels by educational attainment across all countries and cohorts (Figure 6a). The lowest educated men have by far the highest levels of childlessness, while the differences in childlessness between medium and highly educated men are largely nonexistent (except in Finland). The striking difference in childlessness between men with basic education and those with higher levels has persisted across all cohorts in all countries. The gap has even increased somewhat as the increases in childlessness among medium and highly educated men have plateaued. Again, Finland deviates from this pattern. Among the youngest male cohorts, the difference in childlessness between the lowest and the highest educated men lies between 9 percentage points (Sweden) and 15 percentage points (Finland). Unlike in the other countries, Finland also has a clear difference in childlessness between men with medium and high educational attainment.

The levels of childlessness among men with only a basic education in the most recent cohorts are very high. More than a third (34–36 percent) of low-educated men born in 1965–69 in Denmark and Finland and more than a quarter (27–29 percent) of those born in Norway and Sweden remained childless at age 45.

The educational differences in childlessness and the development of those differences have contrasted sharply between women (Figure 6b) and men. In the oldest female cohorts in all countries, childlessness was clearly highest among the highly educated. It exceeded the levels of low-educated women by 4 to 9 percentage points. However, these patterns have changed entirely. In the most recent cohort, childlessness levels are highest among the lowest educated. The gap between the lowest and highest educated ranges from a narrow 1 percentage point in Finland to 8 percentage points in Sweden.

These developments have been similar in every country. Childlessness among low-educated women has increased almost continually, while the childlessness levels among medium and highly educated women have either remained stable, plateaued, or even slightly decreased. Thus, the gap in childlessness between highly and medium-educated women has narrowed across cohorts in all countries and has virtually vanished among the youngest female cohorts.

The stable or slightly decreasing levels of childlessness among highly educated women and the increasing levels of childlessness among highly educated men have also led to a reversal of the gender gap in childlessness among the highly educated in Finland, Norway, and Sweden. Among the older cohorts in these countries, highly educated women used to remain childless more often than highly educated men; among the younger cohorts, this pattern has changed. In more recent cohorts, highly educated women remain childless less often than highly educated men.

If we compare women's and men's development in childlessness across cohorts, we find an increase in gender similarity in childlessness patterns. This convergence has been driven by changes in ultimate childlessness with regard to the educational segments of women, while educational differences in men's childlessness have not changed substantially. Meanwhile, we find an educational disparity in the younger cohorts that is similar for women and men. Overall, childlessness among the medium and highly educated seems to stabilize or even decrease, while childlessness among the low educated has risen. As a result, in the youngest cohort, childlessness levels are highest for the lowest educated, and this trend applies to men as well as women.

Discussion and conclusions

Using harmonized longitudinal individual-level data drawn from national population registers, we explored the development of ultimate cohort fertility and ultimate childlessness for cohorts born since the 1940s in four Nordic countries and compared the potentially gendered developments of educational differentials in fertility outcomes. In all four countries, the segment of persons with only a basic education has shrunk among both sexes. Among men, upper-secondary education is now the most common level attained, whereas among women, tertiary education has expanded substantially. These gendered developments have led to a reversal of the educational gender gap to women's advantage. Comparing the development of ultimate fertility and childlessness across cohorts in the Nordic countries, we find strikingly similar trends in all countries, with the partial exception of Finland. The levels of ultimate fertility have remained fairly stable, and differences between countries have effectively disappeared, especially with respect to female CTF. Childlessness increased in the early cohorts in all countries and more so among men than among women. In Finland, it increased across all cohorts.

The associations between gender and education in fertility outcomes have undergone fundamental changes across the cohorts. The developments are quite similar in the four countries. For men, educational fertility differentials have not changed substantially. In line with previous research on men's fertility (e.g., Trimarchi and van Bavel 2017; Miettinen et al. 2015), we find that low-educated men have lower completed fertility and higher childlessness than medium or highly educated men. These disparities show a remarkable persistence across cohorts.

In contrast to men, women's educational fertility differentials have changed substantively. Contrary to findings from many other European countries (e.g., Beaujouan et al. 2016), the negative educational gradients in CTF observed in older female cohorts have disappeared. Among women in the younger cohorts, no differences are discernible in ultimate fertility between educational categories of women (except in Finland where slight differences are still observed).

Changes in women's education-specific levels of childlessness are even more pronounced than the changes in the CTF levels. In all four countries, the childlessness of highly educated women remained fairly constant or declined slightly. Childlessness levels of medium-educated women converged towards those of the highly educated. In contrast, childlessness among low-educated women has been on an almost continual rise and has surpassed the levels of highly and medium-educated women. These differential trends have led to a reversal of the educational gap in childlessness among women. Highly educated women from the older cohorts had higher levels of childlessness than lower educated women, but in the youngest cohorts, the levels of highly educated women are the lowest.

The developments in women's and men's educational fertility differentials have brought about a new pattern of gender similarity. The 'convergence across gender lines' in childlessness among the low educated is particularly noteworthy. In our oldest study cohorts, childlessness levels were highest for low-educated men and high-educated women, whereas in younger cohorts in all countries, childlessness is highest for the low educated regardless of gender. The new gender similarity accompanies a new 'divergence across educational lines' in fertility outcomes. The development of the youngest cohorts indicates that social inequality in childbearing is intensifying in that lower educated persons are increasingly left behind in family formation and that this applies to women and men equally.

How can we interpret these results in light of the outlined theoretical framework, namely, economic considerations, gender-equity assumptions, and institutional aspects, that links education and fertility? Our study can only provide hints about the numerous factors at play behind the developments we have observed. Our findings suggest that the fertility-stimulating effects of socioeconomic resources may have become more important for both women and men. If education is taken as a proxy for a person's earnings potential, having a sufficiently high income or having the economic means to sustain a family may have become an increasingly important prerequisite for having (more) children for both women and men. The Nordic countries have numerous services and income transfers that should encourage childbearing among all social groups, but having children still appears to have become increasingly difficult for low-educated women and men. Additionally, the difficulties reconciling a career with family building that previously hampered the childbearing of highly educated women in particular seems to have been overcome.

We find some support for recent family-demographic gender theory and for the importance of institutional factors in shaping family-demographic outcomes. We assume that the gender-egalitarian ideology of the Nordic welfare regime, which originally targeted mainly women (Hernes 1987), contributed to halting increases in childlessness and declines in ultimate

fertility. Institutional support for parents, particularly day care for children and support for mothers to remain in the labor force and for fathers to engage in childcare, eased the burden for mothers, countered the negative career consequences of motherhood, and reduced conflicts between women's employment and family care. This orientation of the Nordic welfare regime seems to have mitigated the negative consequences of increased female education and labor-force participation on fertility.

Our findings have major implications for demographic research. They underline the need to carefully scrutinize the schemas of gender and social strata (here, education) that are applied in fertility research. As other researchers have also noted, we should be wary of the widely held notion that highly educated women have higher opportunity costs than low-educated women and that they therefore have fewer children than low-educated women (see also: Hoem et al. 2001; Andersson et al. 2009). This notion rests on the assumption that mothers are the sole caregivers of children and that motherhood and paid employment are strongly at odds, and it overlooks the value of available childcare, parental leave regulations, and partner's engagement in childcare, all of which may reduce any opportunity costs. Overall, opportunity costs may not be as important as is usually assumed. Even if highly educated women have the largest earnings losses following from family leaves (Evertsson 2016; England et al. 2016), their remaining income may still be more than sufficient to maintain the family's previous level of living, while the comparatively lower earnings loss of low-educated mothers may make it difficult for those women to make ends meet. Our research results clearly suggest the need to modify the existing economic concept of motherhood and to view women as breadwinners just as men are.

The widening of the educational gap in childlessness for both women and men supports our presumption that fertility research should focus more attention on family demographic developments among the low educated. With the increase in women's and men's educational attainment, the low educated have become an increasingly marginalized population segment not only with regard to their labor market position but also with regard to family formation. In the Nordic countries, affordable high-quality childcare has long been available to all children, and most fathers participate in childrearing. Therefore, the increase in childlessness among the lowest educated may not be readily explained by existing theories, such as gender theories on the division of work and care within the family. In particular, the decline in marriage and increase in union instability are other developments that may increasingly hinder childbearing, particularly among the lower educated (Jalovaara and Fasang 2015; 2017). The lowest educated have the lowest likelihood of forming cohabitations and marriages and highest likelihood of union dissolution; indeed, recent research suggests that the negative educational gradient in men's childlessness operates chiefly via selection into union (Trimarchi and Van Bavel 2017). The importance of unions as mediating factors is largely missed by the theoretical discussion on the changing links between gender, education and fertility, as it focuses on couples. Overall, our research suggests that understanding fertility development in light of increased educational attainment and the reversal of the gender gap in education requires more thorough investigations of the demographic consequences of the increasing economic and social marginalization of low-educated women

and men. Clearly, the currently prevailing demographic research perspective ‘from above’ needs to be complemented by a perspective ‘from below’.

Theories on men’s fertility highlight men’s position as family breadwinners and, more recently, as caregivers as well. Many researchers have noted the need to expand fertility research to include men (Bianchi 1998; Goldscheider and Kaufman 1996). Our research supports this view and further suggests that a gender comparison is an essential approach. A gender comparison of fertility developments allowed us to detect the increasing gender similarity, the increasing marginalization of the low educated that embraces both men and women, and the drastic change in the link between education and fertility among Nordic women but not among men. Our research suggests that empirical and theoretical efforts to illuminate men’s fertility behavior and the intersection of gender and social strata should not concentrate only on men but should use a gendered perspective.

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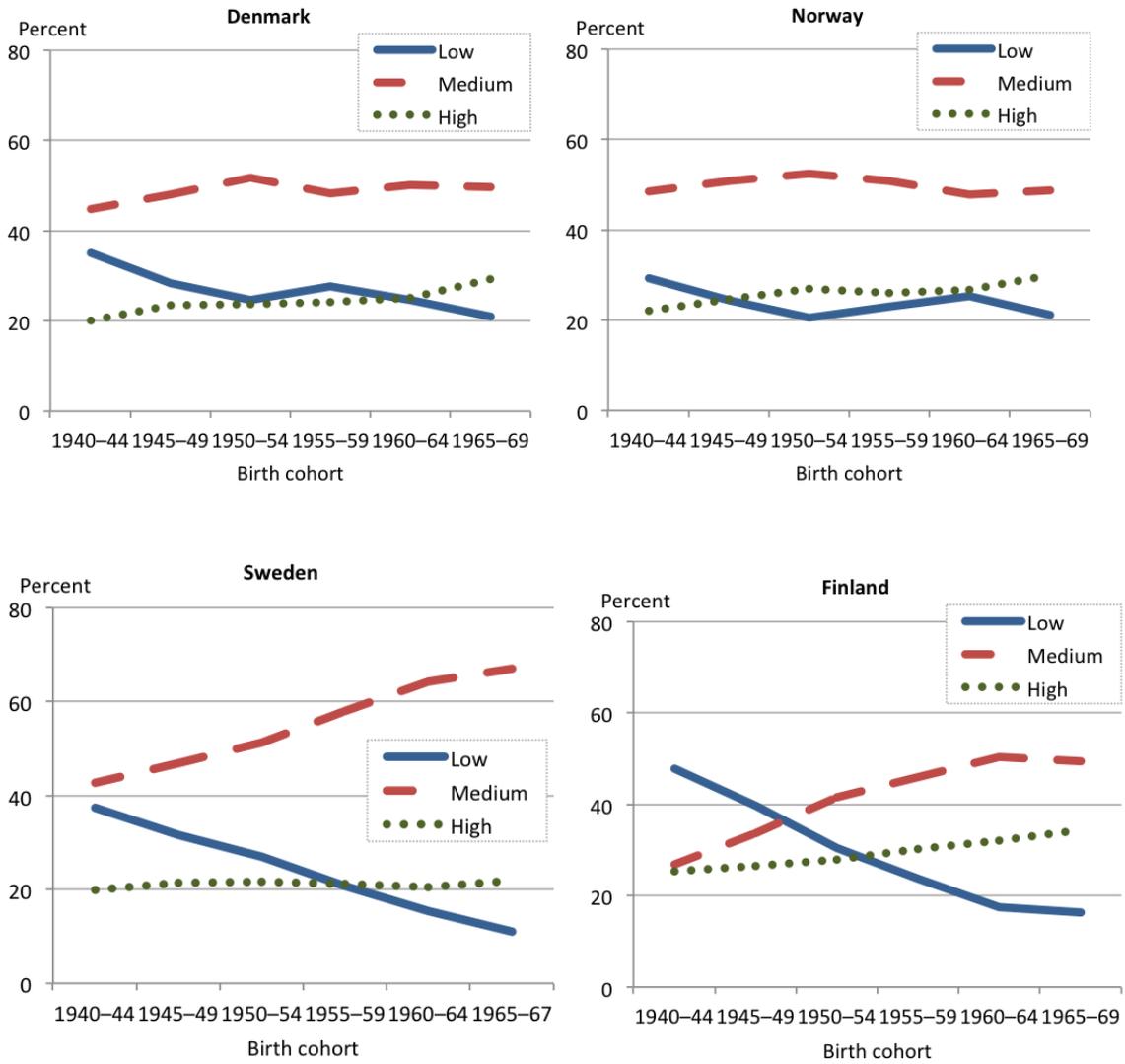
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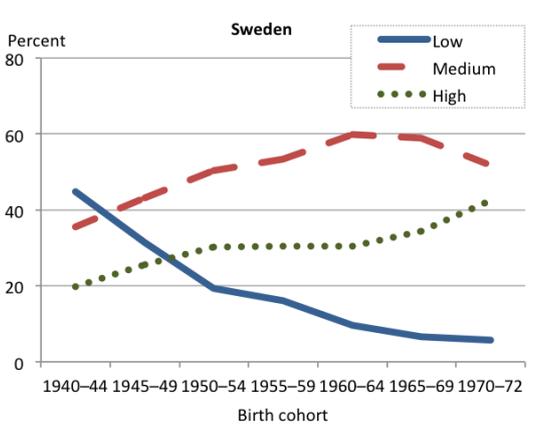
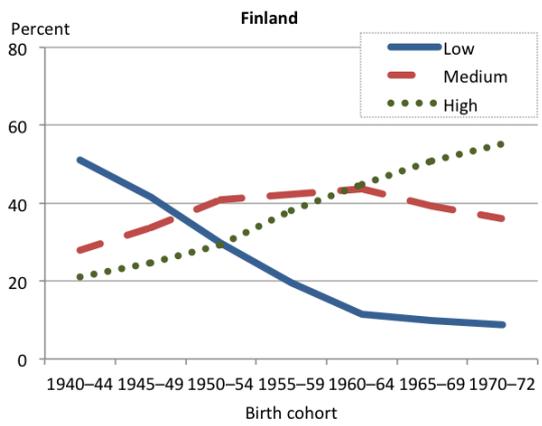
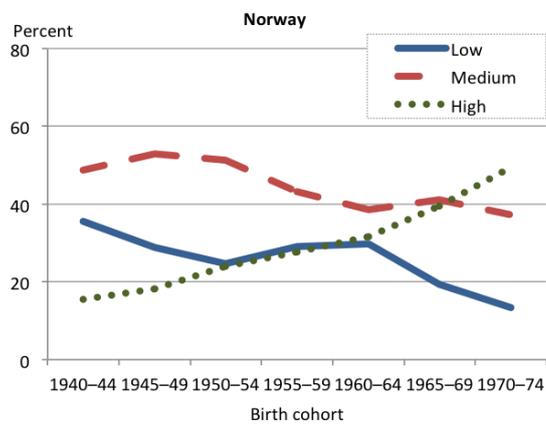
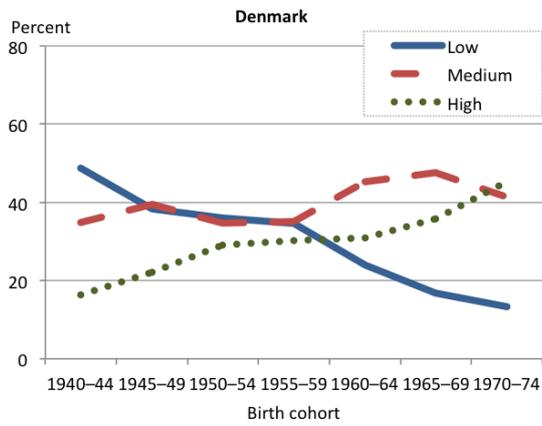
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FIGURE 4: Educational level for men (at age 45) and women (at age 40) in five-year cohorts born in each Nordic country, 1940–.

4a. Men: educational level at age 45



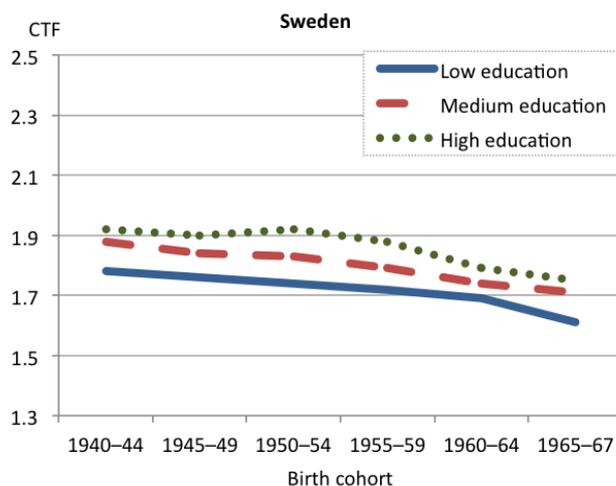
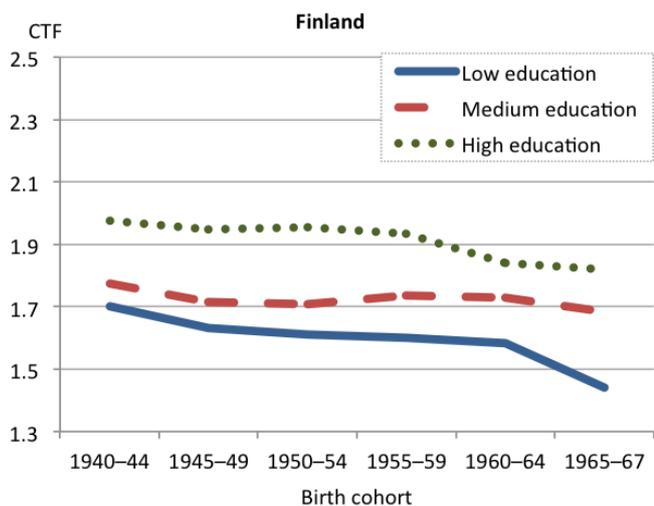
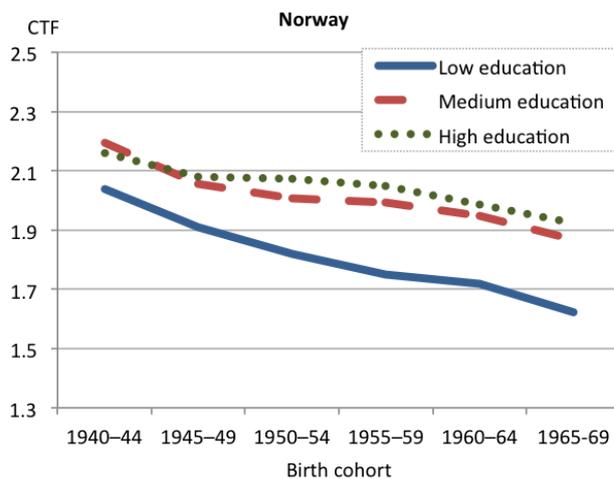
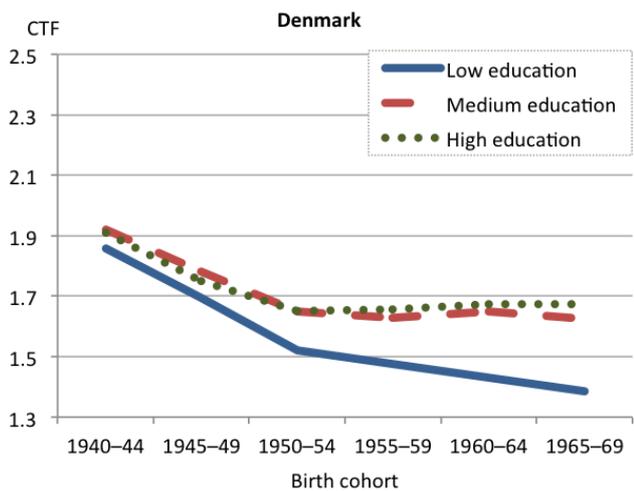
4b. Women: educational level at age 40



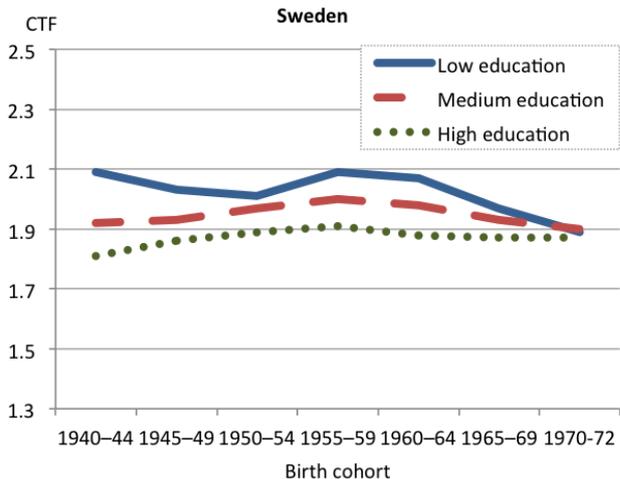
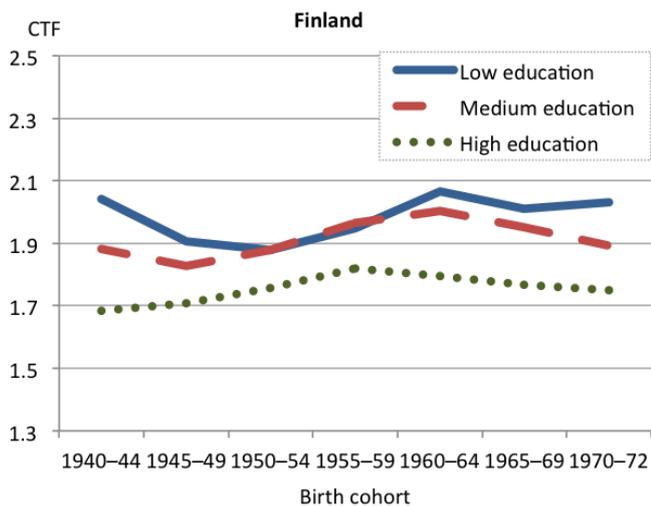
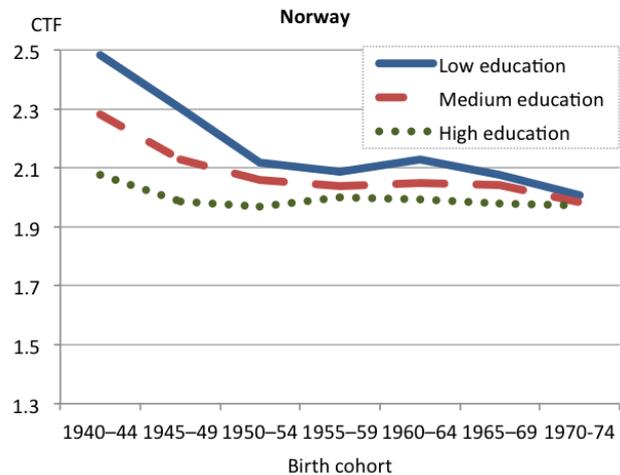
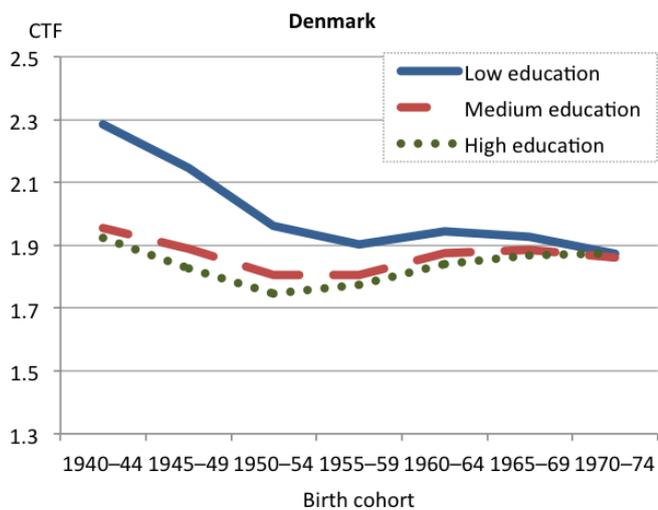
Source: Nordic register data, authors' own calculation

FIGURE 5: Cohort Total Fertility for men (at age 45) and women (at age 40) by educational attainment in five-year cohorts in each Nordic country, 1940–.

5a. Men: Cohort Total Fertility at age 45



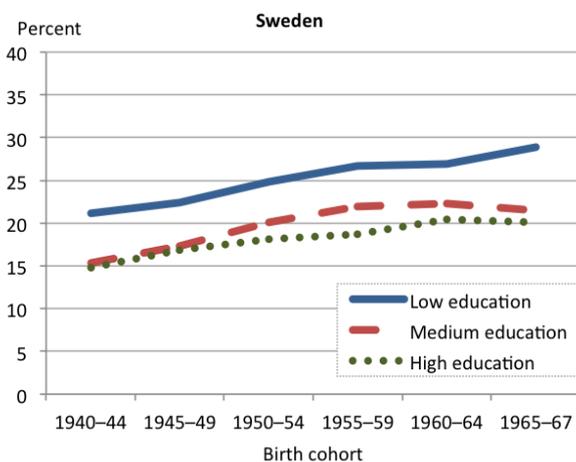
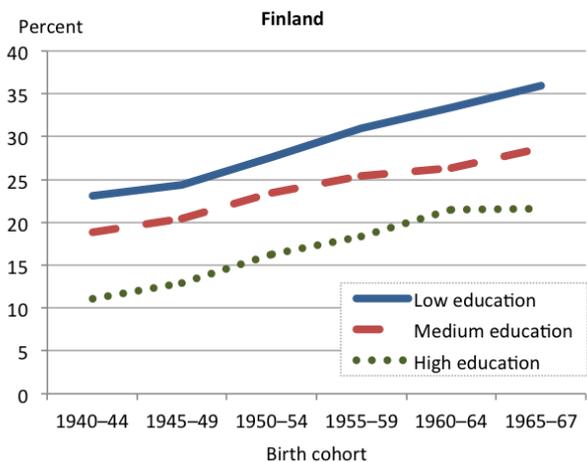
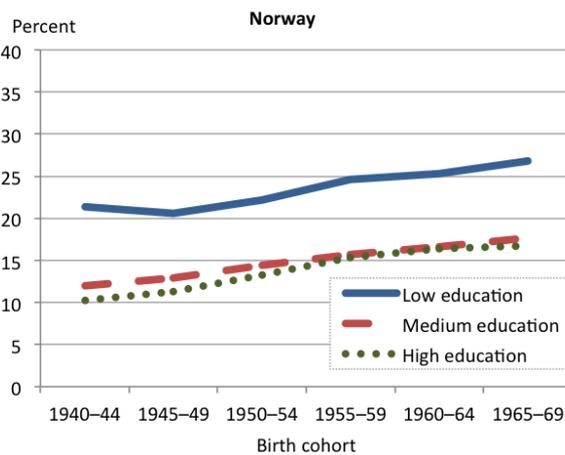
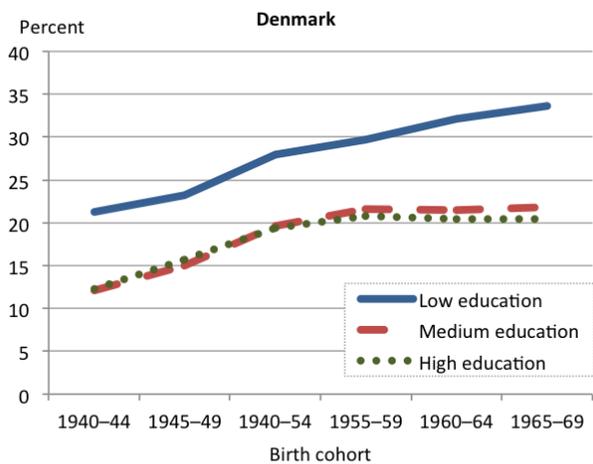
5b. Women: Cohort Total Fertility at age 40



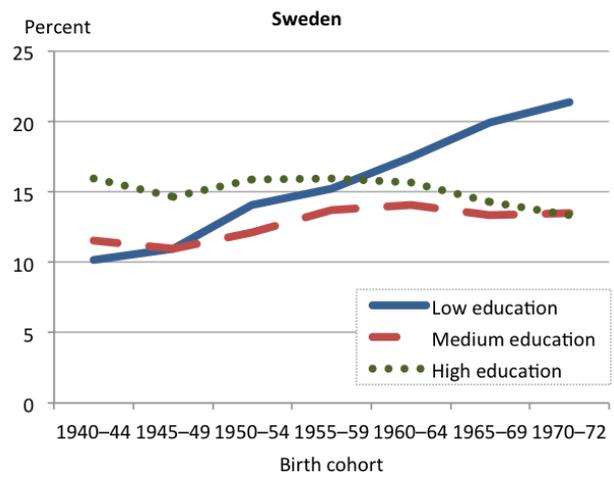
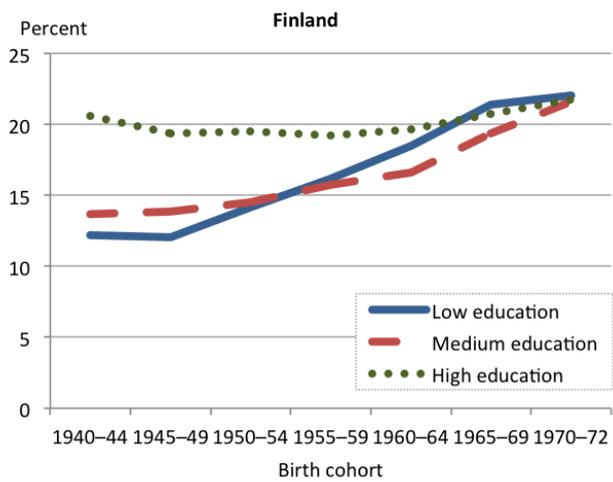
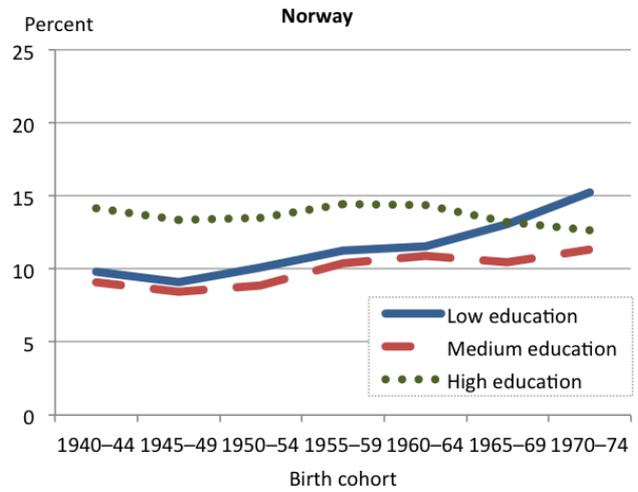
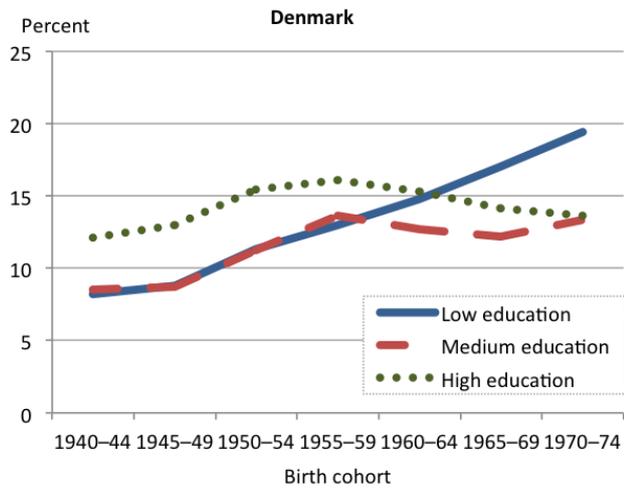
Source: Nordic register data, authors' own calculation

FIGURE 6: Childlessness (%) at age 45 (men) and 40 (women) in five-year cohorts born in each Nordic country, 1940–.

6a. Men: childlessness at age 45



6b. Women: childlessness at age 40



Source: Nordic register data, authors' own calculation