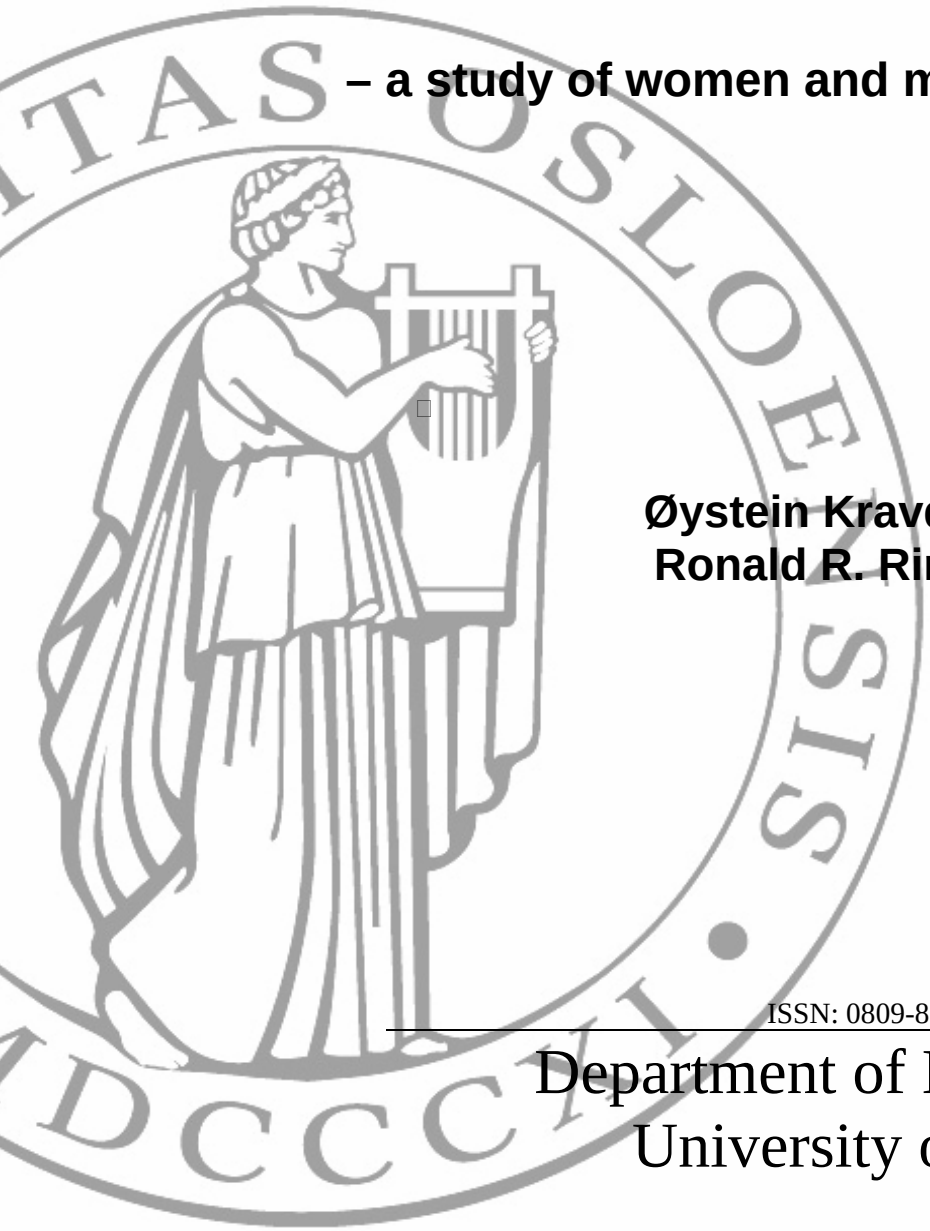
MEMORANDUM

No 11/2007

Changing relationships between education and fertility

– a study of women and men born 1940-64



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Changing relationships between education and fertility – a study of women and men born 1940-64*

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Changing relationships between education and fertility – a study of women and men born 1940-64

ABSTRACT

Surprisingly, relatively little is known about the relationship between education and completed fertility in low fertility countries and especially the trend in this relationship over time. An inverse relationship is expected, but the topic has been left largely unexplored for at least a generation, and for men the topic is almost completely unexplored empirically. In this paper, we use data from the population registers covering all Norwegians born 1940-64. Among women, the relationship between completed fertility and the educational level attained at age 39 has become substantially less negative. In all the cohorts, better educated women have more often remained childless than the less educated, and they have had later first births, which also contributes to lower subsequent fertility. However, the negative effect of education on higher-order birth rates net of this impact of later motherhood has disappeared in the younger cohorts. Family-friendly policies and ideologies, leading, for example, to better access to high-quality day care, are likely the main engine behind this shift. Among men, a positive relationship has emerged. The better educated become fathers later than others, but fewer remain childless, and there has been an increasingly stimulating effect of education on second- and third-birth rates. We discuss these sex differences in the light of the persistent differences between mother and father roles.

INTRODUCTION

What is the relationship between education and fertility in developed countries, and how does it vary between men and women as well as across time? Childbearing is the process whereby generations replace themselves with new generations, and reproductive differences by education sets the stage for the educational level of parents rearing the next generation. And, in turn, in developed, post-industrial countries, education is the principal process by which each new generation acquires the skills and credentials needed for their work lives, as well as civil and other responsibilities. The interconnection between these two processes in the social and demographic metabolism of societies has long been recognized (Ryder 1965), and, at the individual level, this interconnection has made it difficult to disentangle causal relationships between education and fertility.

There certainly has been considerable research on the interrelationships between education and fertility. (See United Nations 2004 for a major review.) For the past 35 years or so, attention has focused on the timing of the transition to motherhood, with the problem of adolescent fertility receiving considerable attention from American researchers. There has also been some research on other fertility building blocks, such as the progression from first to second or second to third birth (e.g. Hoem and Hoem 1989; Köppen 2006), but little focus on how these components come together to shape the overall relationship between education and fertility for women, and how this relationship has changed over time. Such a change over time is indeed likely, because in developed countries educational attainment has been rising for both men and women, but more rapidly for women such that traditional educational differences by gender have declined and, in some cases, reversed. Besides, in many countries, discrimination against women in the labor force has been reduced, the use of child care has become increasingly acceptable, and fertility has fallen to levels well below

replacement. This lack of knowledge about the relationship between education and completed fertility, and trends therein, is linked to the ascendancy of fertility surveys of women of childbearing age coupled with the elimination of fertility questions on censuses. For many developed countries, the appropriate data for such analysis simply does not exist.

Even less is known about the relationship between education and fertility for men. So far, men have been brought into fertility analyses primarily in two ways: The socio-economic characteristics or fertility intentions of spouses have been taken into account in individual- or couple-level analyses (e.g. Sorenson 1989; Thomson and Hoem 1998), or men's wages or other aggregate characteristics of the male population have been considered potential determinants of various aggregate measures of women's fertility (e.g. Butz and Ward 1979; Gauthier and Hatzius 1997; Macunovich 1996). However, as pointed out repeatedly, few efforts have been made to describe and analyse how many children *men* have and when they have had them (Coleman 2000; Green and Biddlecom 2000; Goldscheider and Kaufman 1996; Forste 2002). Instead most efforts have been focused on fathers who are absent rather than on male fertility per se (Bianchi 1998). Part of the lack of attention to male fertility is due to the absence of appropriate data (e.g. Clarke et al.1998), but more fundamentally, the lack of attention is consistent with social demography's focus on reproduction, and women's central role in the birth process. The very small number of studies that *have* addressed the education-fertility relationship for men have tended to examine a component of the fertility process, for example the first birth (Liefbroer and Corijn 1999; Toulemon and Lapierre-Adamcyk 2000;Dribe and Stanfors 2006), and not the entire fertility process.

In this paper, we first review and develop reasons for educational differences in fertility, and why they might vary by gender and over time. Then, using data from the rich Norwegian population registers, we describe how education is related to completed fertility and parity progression ratios for birth cohorts 1940-1964 for men and women. In addition,

we estimate hazard regression models to see whether the educational differentials in second- and third-birth progression ratios are merely a consequence of the higher age at first birth that is typically seen among the better educated. These models are estimated jointly for first-, second- and third-birth rates, with a common unobserved factor, to take selection into account and get a cleaner picture of how education affects the particular progression rate in focus. To preview our results, there have been substantial changes over time in the relationship between education and fertility, and the pattern of the relationship is quite different for men and women.

THEORETICAL FRAMEWORK

Education's effect on fertility can operate through four mechanisms that have been discussed in the literature (balancing roles, affording children, using knowledge gained in school, and finding a partner), and fertility can, in turn, have a feedback effect on education through the balancing roles mechanism. We discuss each in turn. Throughout, we make the assumption that women are the primary occupants of the mother role, that is, caring for the day to day needs of children. Apart from arguments about breastfeeding, there is no necessary reason why this has to be the case, but empirically it is found in virtually all settings. It is this difference in the occupancy of the mother role that is the main reason to expect male-female differences in the education and fertility relationship. It should also be pointed out that whenever we suggest an impact on first-birth timing completed fertility will likely be indirectly affected. The reason is that an earlier start to childbearing leads to a longer exposure to additional births, and remaining childless up to an older age may stimulate interests that compete with the parental role (Kohler, Billari and Ortega 2002; Marini and Hodson 1981; Morgan and Rindfuss 1999).

There are several aspects of education that may be important for fertility. Obviously, being enrolled in school, and having plans to continue schooling in order to attain certain educational goals, is itself likely to have an impact, which is the first issue we elaborate on below. Credentials are important in obtaining jobs that are interesting, flexible and high paying. Further, one may be influenced by the way of thinking one is exposed to by being in an academic environment, as well as the general or job-specific skills that are taught.

Balancing roles. Consider first the student and parent roles. It is a rather simple truism that the mother role takes time, especially with preschool age children, and this truism is at the heart of sociological arguments about the relationship between education and fertility (e.g. Stycos and Weller 1967). The student role also takes time, and it is difficult to do both simultaneously without having someone available to mind the children while the parent is in school or doing school-related work. A common argument is that female students who have children may find it difficult to complete their education, with consequences for later occupational achievement and income, so that they would be better off in the long run if they postpone parenthood (e.g. Happel et al. 1984). Thus the expectation is that childbearing will be postponed while the young woman is in school, especially if she has aspirations to achieve a relatively high level of education. This argument is weakened to the extent that efforts are made to facilitate the combination of parenthood and school enrolment, such as those that have been made in Norway, some school districts in the United States, and elsewhere; but even weakened, the argument is still likely to apply. Given the large difference in most aspects of daily life between having no children and having at least one, the argument about enrolment is more related to the transition to parenthood than to subsequent parity transitions, and especially at the younger childbearing ages when enrolment is common.

Since the male parent is rarely in the mother role, the direct conflict between school enrolment and the mother role tends to apply less to them. But, it is difficult for a man enrolled in school to simultaneously earn the wages the mother of his child might expect, enrolment for men would indirectly lead to a delay in childbearing. We return to the issue of affordability below.

Now consider parent and worker roles. Women with higher levels of education tend to have jobs with higher wages because of their skills and knowledge as well as the credentials themselves. This means that they have more to lose in the short run by staying home to care for a child, which may contribute to a delay or a reduction in fertility (Becker 1991; Becker and Barr 1988; Becker and Tomes 1976; Willis 1973). Besides, women with higher levels of education generally have better possibilities to establish careers, that is, a series of jobs that progressively involve more responsibility, higher pay and more interesting work activities. Being home with a child for some period, and perhaps especially early in the career, may be seen as reducing the chance of following such an upward trajectory. For men, given that they are less involved in the mother role, these arguments related to short- and long-term opportunity costs of childbearing are less relevant.

An increase in availability and acceptability of non-family childcare, which has occurred in some countries (e.g.Bumpass 1990; Rindfuss et al. 1996), can mitigate the depressing effect of women's education through opportunity costs (see Ermisch 1989). To see the argument, first assume a positive relationship between a woman's education and her wage potential. Further assume that child care is being used to allow the mother to work, as opposed to help socialize the child or other reasons. If a mother can return to work, say, one year earlier by using child care than she otherwise would have been able to do, her opportunity costs would be reduced. This reduction would be particularly large if she has a high education (and income) compared to another mother with lower education (and income).

Thus, the depressing effect of women's education through opportunity costs decreases. In principle, this advantage for the better educated may be set off against the higher child care costs that those with high incomes may have to or want to pay, but these differences in child care costs over a one-year period are, in most settings, lower than the differences in annual incomes.

In addition, the better educated often have jobs with some flexibility regarding when during the day and week the job needs to be performed, and flexibility in bringing some of the work home to perform when the children are sleeping or otherwise occupied (e.g. Swanberg et al. 2005). Such aspects of the jobs of the better educated can also mitigate the depressing effect of women's education through opportunity costs by facilitating an earlier return to the labor market.

Having children typically increases the amount of housework that needs to be done, and even if a child is in full-time day care, there is much care that still needs to be provided by the parents. Although these tasks involve an interaction with the child that is seen as valuable and one of the reasons for having children, it also leads to less time available for various leisure activities. In other words, the balance between child-related duties and other activities besides work and studying is also an issue in fertility decision-making. Some studies have shown that better-educated women and men share housework more equally with their partners and also spend fewer hours doing such work than the less educated (e.g. Kitterød 2002; Bianchi et al. 2000). The sharing of housework among the better educated has increased over time, and, logic extended, one would expect the better educated to be more likely to share childrearing duties as well. The possible lower burden of child rearing among the better educated women might increase their interest in having more children (e.g. Torr and Short 2004; Olah 2003). Clearly, it is only after a couple has a child that they really know the extent to which child care chores will be shared by the father and mother. Hence, the link

between education, sharing of housework and fertility is expected to be weaker with respect to the first birth than subsequent births.

It is crucial to realize that the balancing roles arguments also involve a feedback loop from childbearing to education. For both men and women, it is difficult to combine the parent and student roles. Hence, if for whatever reason a person becomes a parent prior to finishing all the schooling that they had intended to finish, the fact that they became a parent is likely to reduce the amount of schooling that they eventually achieve.

Affording children. Children in developed, low fertility countries are expensive, even if part of their education and other expenses are subsidized by the government. For example, the USDA estimates that total direct expenditures for the first 18 years of life for a child born in the U. S. in 2004 would be $134,370 (in 2004 dollars) for a lower income family, $184,320 for a middle income family and $269,520 for a higher income family (Lina 2005). Adding college costs would obviously substantially increase these numbers. Even if prospective parents are unlikely to be aware of exactly how much children cost, they are likely to at least have some sense of magnitude. In addition to such direct expenditures on children, parenthood also entails opportunity costs, as mentioned earlier (Kravdal 1992; Davis et al. 2000).

Given the expectations about how much to spend on each child ("child quality") and material aspirations more generally, economic theory predicts that a high income stimulates fertility, which would contribute to a positive correlation between education and fertility. With special relevance for first births, it is also suggested that those who expect an income increase are particularly likely to delay childbearing, and especially if the income is low at the outset (e.g. Happel et al. 1984). For these reasons, one would expect better educated men to have higher completed fertility and birth rates to be low during school enrolment. For women,

the issue of opportunity costs complicates the argument. Without the opportunity costs issue, since better educated women should have higher wages, they should be able to afford more children. The extent to which this is the case depends on how long they are out of the labor force with each child, that is, the opportunity costs. Further, if there is positive assortative mating with respect to education, the high wages of one well-educated partner should reinforce the high wages of the other (see further discussion of assortative mating below). A final, and key, issue is, of course, whether an "income effect" is outbalanced by higher child quality requirements and material aspirations among those with high education and incomes.

Knowledge.To what extent might knowledge acquired either in school or as a result of having higher levels of education affect fertility? In principle, one possibility is that there is an educational gradient in the knowledge of contraception and abortion even in post-demographic transition societies. That might affect both the timing of parenthood and the total number of children, and since the most effective methods tend to be female, one may expect women's education to be more important than men's. The evidence is not strong, however. While it has been reported that the better educated used the new contraceptive techniques to a relatively large extent in the 1970s (e.g., Østby 1989), and that they have less often experienced unplanned pregnancies or an unmet need for contraception than the less educated (e.g.. Henshaw 1998; Kost et al. 1995; Klijzing 2000), this does not necessarily reflect differences in knowledge. Anyway, if there ever was such an educational knowledge gradient among women brought up in a low-fertility setting, it is likely to have been wiped out now because of a general diffusion throughout the population.

There is a second knowledge issue that could lead to the same outcome. The transition to parenthood brings about a sharp change in responsibilities and in numerous aspects of everyday life. It may be that the better educated are more cognizant of the realities of the

transition to parenthood. This may come about because of explicit material they are taught in school. For example in some American school districts, high school students are given explicit instruction on the realities of being a parent, using a infant simulator doll that the students carry with them and care for over several days (Kralewski and Stevens-Simon 2000; Strachan and Gorey 1997). Or it could be that the better educated are more aware of the realities of parenthood through reading and observation outside the formal education system. Either way, to the extent that the better educated are more aware of the realities of parenthood the more likely they will work to carefully time entry into parenthood to fit with other aspects of their lives. This should lead to a later timing of the first birth.

Moreover, education promotes the ability to think for oneself and critically examine arguments put forth by others. This is not knowledge per se, but rather skills and a philosophy. To the extent that there is or was normative pressure to have two children, as suggested by Blake (1968), the better educated may question or resist such pressure more than others. In fact, some have argued that more education leads people to take individual decisions with respect to family behavior, rather than being driven by, for example, religiously based traditions (e.g. Lesthaeghe and Surkyn 1988).

Finally, it is possible that education can open one's eyes to various leisure pursuits (e.g. engaging in some sport, acting in a local theatre group, or working with some volunteer organization) or avocational interests (e.g. breeding dogs, growing prize roses or making pottery). These activities can be quite time consuming, and better educated men and women may postpone childbearing and/or curtail the number of children they have in order to pursue such interests (e.g. Miller 1992**).** Once again, since women are more likely to be in the mother role, such a balancing effect is likely to be stronger for them.

Finding a partner. Even if they are not married at the birth of a child, with few exceptions, conception and birth occur within a relationship between the mother and the father. This could be a cohabiting relationship, a dating relationship or some other type of relationship, but it is a relationship. At any age, the chance that the person has a child depends in part on whether he or she is in a relationship at that time, the type of the relationship, and the characteristics of the partner (and, conversely, childbearing plans may affect the partnership status). The entry into and stability of the partnerships are in turn influenced by education.

A classic economic argument with respect to marriage formation and extended more generally to partnership formation is that specialization constitutes an important component of the value of a relationship, so that the couple having the most to benefit by forming a relationship would be a man with high wage potential and a woman with lower wage potential, all else similar (e.g. Becker 1991). This would advantage men with higher levels of education, and those at the bottom of the educational spectrum might be most likely to never enter a partnership that produces a child. Similarly, women with the highest level of education may be less likely to ever enter a partnership that produces a child. On the other hand, education does not only affect people's wages. There are also other characteristics associated with education, such as being an interesting discussion partner or a good problem-solver, and these may increase both a woman's and a man's attractiveness as a marriage partner.

The argument related to wages has been contested, given that family instability has made specialization more risky, and many of the services traditionally produced in the home are less time-consuming or can be purchased. For example, Oppenheimer (1994) has argued that it is a pooling of resources that now produces the economic benefits from living in a union, rather than specialization, so that men prefer wives with a high wage potential, just as women prefer rich husbands. The implication of this would be that better-educated women are

the most prone to marry or form a partnership, once their lower marriage rates during enrolment are taken into account.

To summarize, while all arguments suggest that men with the lowest level of education are least likely to form a partnership that leads to one or more children, it is less obvious what one should expect for women. Possibly, there has been a development away from the specialization strategy, so that effects of women's education have become less negative or perhaps even positive.

An additional issue is: once partnerships are formed, how educationally homogenous are they? The higher the level of educational homogeny within partnerships, the more similar will be the relationship between education and fertility for men and women. At the extreme, if all men and women formed partnerships, and if these partnerships were educationally homogenous, then the relationship between education and completed fertility would be the same for men and women.

Summary. We have now reviewed several reasons why education may affect first- as well as higher-order birth rates. Some mechanisms contribute to push fertility up, others to depress it. On the whole, it seems likely that the positive contributions have become relatively more dominating over the years, and that they count more heavily for men than for women. However, so far there is very meagre empirical evidence for this.

DATA

Our analysis is based on data from various Norwegian registers that cover the entire country and are linked together by means of a personal identification number. We restrict the analysis to the 1940-64 birth cohorts, all of whom were at least 39 years old in 2003, the last year of

available data. By age 39 they had largely completed childbearing. We leave out the 9% who were not born in Norway. Those residing in Norway but born elsewhere are a very heterogeneous group, ranging from children of diplomats posted overseas to immigrants from a wide variety of countries and occupying a diversity of occupations. These 1940-64 cohorts include approximately 1.5 million women and men; this large number of cases permits analyses not feasible with the typical sample survey.

Birth histories, which include date of birth for each child for whom the person is registered as a parent, were taken from the Central Population Register. These histories are essentially complete for all women in the selected cohorts, and there is very modest underreporting for men (for approximately 2% of the births in Norway during these years, a father was not registered). There is evidence that, in retrospective fertility surveys, men underreport the number of children they have had, especially if they no longer co-reside with the child and have limited contact with him or her (e.g. Juby and Bourdais 1999). A virtue of the Norwegian data is that they are prospective, and hence their quality and completeness is unlikely related to the nature of the relationship the parent has with the child as the child ages.

Education is obtained from education register files produced by Statistics Norway. We know completed education at age 39 for the entire series of cohorts (except the 1940 cohort, for which we need to use education at age 40). Educational level was coded according to the 2000 standard (Statistics Norway 2001) into five categories: i) only compulsory education (10 years of schooling), ii) lower-secondary education (11-12 years), iii) higher-secondary education (13 years), iv) some college or university education, up to and including the Bachelor level (14-17 years), and v) all college education taking 5 or more years, for example the Master's degree (18 or more years). In addition, there are a small number of people (approximately 1%) with unknown education or compulsory school not completed. The third category, "higher secondary education," is roughly the equivalent of the first year of college

or university in the United States. The fifth and highest category includes two different types of educational programs. Some obtained their Bachelors degree and then went on to obtain an advanced degree, such as a Masters or Doctoral degree. Others, after completing their higher-secondary education, entered a program of study, such as medicine or veterinary science, that does not confer a Bachelors degree but rather after a somewhat longer period of study confers an advanced degree such as MD.

THE NORWEGIAN SETTING

The oldest cohorts included in this study took their secondary or tertiary education and started having children in the late 1950s. The youngest cohorts reached this stage in the late 1970s and have just recently finished their childbearing. During the half-century that is covered, Norway has changed markedly. Most importantly from the perspective of this study, each cohort has taken more education than its predecessors, child care has become more widely available, parental leave benefits have increased, and there has been a steady drift away from formal marriage. We now elaborate on these changes.

Compared to the education system for today's Norwegian children, for these cohorts compulsory school started later (age 7) and lasted shorter (first 7 years and then 9)[1]. After compulsory education is complete, adolescents may enter high school, which has two different three-year tracks, one vocational and one theoretical. There is great flexibility in the secondary school system. Students have opportunities to quit school and return, to change from one track to another, and to spend extra time in order to attain more than one "degree" (for example theoretical plus one vocational, or two vocational). A theoretical high-school

[1] This change in the definition of compulsory school has been taken into account in the coding used.

education may be followed by a college or university education. Some students may take only a few courses at this post-secondary level, some may earn the equivalent of a Bachelor degree, perhaps followed by a higher degree, while others may take "professional" education. Flexibility also exists at the post-secondary stage, so some can finish their degrees at an older age or after many years of enrolment.

To provide a sense of the openness and flexibility of the Norwegian educational system we consider the experience of the 1964 birth cohort, the only cohort among the cohorts examined here for which we have a complete education history. Among members of this cohort who became parents, 21 percent of the women and 20 percent of the men had a higher level of education at age 39 than when they first became a parent.

Norway, like other developed countries, has experienced a rapid educational expansion as a result of economic growth, a stronger need for theoretical knowledge, policies supporting education for the less advantaged, and ideology about women's rights to education. Table 1 shows the educational distribution for each of the cohorts, separately for women and men. The expansion is clear. For example, among women born in 1940-44, 33% had only compulsory education by age 39, while 15% had taken some college education. Twenty years later, the proportions were 8% and 34%, respectively. As has happened in other countries, women have increased their education faster than men, and are now more likely to have some post-secondary education compared to men.

(Table 1 about here)

A number of family policy steps have been taken to facilitate combining work and mother roles in Norway. These policies have not been motivated by concerns about the fertility level, which has been high by European standards; rather, they have been driven by

an interest in promoting gender equality, improving the well-being of individual women and families, and stimulating the national economy by releasing women's work potential. Work-place reforms have been part of this package. For example, there is relatively good access to part-time work, parents have a right to stay home with sick children 20-30 days per year, and the mother is entitled to a two-hour break each day to breastfeed. Further, parental leave has been steadily expanded. It is currently 48 weeks with full wage compensation, and 4 of those weeks are reserved for the father, in an attempt to strengthen the father's involvement with the child from an early age (for further details see Rønsen 2004).

In addition to such work-place reforms, the relatively good access to high-quality affordable childcare is an important reason why mothers can resume work fairly quickly after birth, and hence incur lower opportunity costs of childbearing. For example, 80% of Norwegian children aged 1-5 were enrolled in a day care center in 2006 (Statistics Norway 2007a). These centers may be private or public, but both types are heavily subsidized, and the price varies little, except that many municipalities offer a substantial deduction to families with very low earnings (Rauan 2006). This day care system was being expanded during the time when our cohorts were bearing children (Rindfuss et al. 2007).

To provide some feeling for the cost of day care relative to incomes, the price of care for the year 2006 for a child was less than $4,000, while the median after-tax income for the year 2001 was $65,000 for households consisting of a couple and at least one child younger than 5 (Statistics Norway, 2007b). If there is a second child in day care, the price for that child is even lower in many municipalities. Further, it is not only low prices that make day care centers attractive. They are staffed by specially trained pre-school teachers, the number of teachers and assistants per child is high, and they are open from early in the morning till after usual working hours every work day the year around.

The labor force participation rates of Norwegian mothers have increased steadily. Let us, for example consider women who have two children under age 16, the youngest aged 3-6. In 1980, less than 60% of these women were employed. In 1997, the proportion exceeded 80% (Statistics Norway 2007c). In 1972, the corresponding figure was about 40% (Statistics Norway 2007d).

Partly as a result of developments in education and family-work policies, and partly in response to other social, political and ideational changes, marriage is now much less popular than it used to be. Age at marriage has increased sharply, and a larger proportion never marries (Statistics Norway 2007e). Besides, according to current divorce rates, half of the marriages will be dissolved (Statistics Norway 2007f). This movement away from marriage is, to a large extent, compensated by cohabiting unions (Statistics Norway 2007g). As a result of these trends, most childbearing now takes place outside formal marriage. In 2005, 42% of all births were to cohabiting mothers and 10% to women who were neither cohabiting nor married (Statistics Norway 2007h).

This combination of generous policies and young couples' willingness to have children without being in a formal marriage has contributed to keep fertility high. Since 1988, the period total fertility rate has been in the 1.8 and 1.9 range (Statistics Norway 2007i). This is far above the European Union average of approximately 1.4 (e.g. Sardon 2000).

EDUCATION-FERTILITY RELATIONSHIP

The relationship between education and fertility has changed over time, and the pattern is quite different for men and women. Table 2 shows the average number of children through age 39 for men and women living in Norway for cohorts 1940-1964. Starting with women, it can be seen that the negative association between education and the average number of

children has diminished sharply. In the 1940-44 cohorts, women with compulsory education had 2.46 children, as opposed to 1.99 among those with higher-secondary education and 2.05 among those with some college education. Thus, the difference between the highest and the lowest fertility is 0.47 if the small group with the equivalent of a Master's degree is ignored. In the 1960-64 cohorts, the corresponding difference is only 0.20. This reduction of the education-fertility differential occurred largely among the cohorts from the 1940s. Among those born after 1950, completed fertility remained remarkably stable within all educational categories, even during a time when educational attainment was increasing for the cohorts born in the 1950s and early 1960s (cf. Table 1).

(Table 2 about here)

The education-fertility pattern is markedly different among men. For the oldest cohorts, there was almost no variation by education in the average number of children, though it was always lowest among the least educated. In the younger cohorts, however, fertility is *higher* among men with a full secondary education or more, than among the less educated. The difference is in the 0.1-0.2 range.

In comparing the average number of children for men and women, several factors need to be considered. First, it is important to remember that men have more children after age 39 than women. For example, men born in 1950-54 had on average 0.17 children between age 39 and age 49-53 (2003), varying between 0.13 among the least educated and 0.25 among the best educated. This means that the educational gradient in men's completed fertility was even more positive than it might seem from Table 2. In comparison, women born in 1950-54 had only 0.03 births after age 39, varying between 0.02 and 0.10.

Further, comparing overall fertility levels for men and women, the average number of children for men is consistently lower than for women. This has been seen also in other studies using other data sets (e.g. Coleman 2000). Even if we take into account that men may have about 0.1 children more than women after age 39, there is still a remaining difference of about 0.1. There are several reasons for this male fertility "deficit." There are typically more men than women in a birth cohort until about age 60 because a male surplus at birth dominates over higher male mortality rates. Moreover, there is an underreporting of fathers in the birth registration system, but it is very modest and does not contribute much. In principle, a relatively low male fertility would also occur if the number of children has a more inhibiting effect on women's likelihood of dying or emigrating than men's, or if more women than men have children with foreigners while they are abroad and bring these children back to Norway.

To obtain a better understanding of these remarkable changes in children ever born for women and men, we now examine their main components: percent remaining childless, and the transitions from the first to the second and the second to the third birth.

Childlessness. For women, the largest component of the educational difference in completed fertility is the difference in childlessness (Table 3). For example, 9-12% of the women who were born in 1940-64, and who had only compulsory education, had no children, compared to 14-15% among those with some college education, and more than 20% among those with a Masters or higher degree. Further, for women, these educational differences in childlessness have hardly changed across the cohorts, and hence are not responsible for the narrowing of the female educational differences in children ever born seen in Table 2.

In contrast to this positive association of education and the percent childless for women, among men childlessness has been *highest* among those with low levels of education. For example, 22% of the men at the lowest educational level in the 1940-44 cohorts were

childless, as opposed to 13% in the group with higher education. The size of this inverse relationship between education and childlessness for men has diminished over time but is still evident for the most recent cohorts.

(Table 3 about here)

Among women, average age at first birth, given that they had a birth, increases sharply with increasing education. For example, the numbers are 22, 24, 26, 27 and 30 for the five educational categories in the female 1960-64 cohort, and the steepness of this gradient is similar in the other cohorts (see appendix table A1). There was less variation among men; for example, for men in the 1960-64 cohort the corresponding numbers were 27, 27, 28, 29 and 30. Again, the steepness of the gradients is similar for the other cohorts.

Second and higher-order births. In addition to educational differentials in childlessness, there have been differentials in fertility among mothers. For example, the number of additional children after the first differed by 0.35 between women with compulsory education and those with some college education in the 1940-44 cohorts with a corresponding difference of 0.13 in the 1960-64 cohorts. If we look at differences between compulsory education and higher education, the differences for the 1940-44 and 1960-64 cohorts are 0.57 and 0.21 respectively (not shown). To further examine these differences past the first birth we now turn to transitions to the second and third births.

In the oldest female cohorts, this negative educational gradient in fertility after the first birth was a result of a higher propensity to have a second child among one-child mothers with low education than among the others (Table 4), and an even clearer inverse relationship with education appeared for the third-birth progression ratios (Table 5). As we move towards the

more recent cohorts, the steepness of this education differential diminishes. For example, a difference could hardly be discerned in the second-birth progression ratio for the 1960-64 cohorts, while there was little variation in the third-birth progression ratio except for a somewhat higher level among women with only compulsory education than for the others. We do not show similar tables for fourth and higher-order births because they have become uncommon (only 8% of the women in 1960-64 cohorts had four or more children).

For men, the pattern of change by education differs for the second and third parity progressions. Among the oldest cohorts there is essentially no difference in the proportion moving from the first to the second child; but for the more recent cohorts a positive association has emerged (Table 4). For the progression to the third child given that one had a second child (Table 5), among the earliest cohorts there is a negative association which disappears among the more recent cohorts.

(Tables 4 and 5 about here)

To summarize, there are substantial differences between women and men in the association between education and fertility. Further, for both women and men, this association has changed substantially across the cohorts examined here. The inverse relationship between women's education and completed fertility has become less pronounced. This is a result of less negative educational gradients in second- and third-birth progression ratios, in spite of a persistently large difference in the age at first birth, and a continued negative difference in remaining childless. For men, a rather weak relationship between completed education and fertility has given way to a positive one. This development reflects to a large extent a change towards a more positive educational gradient in the second-birth progression and a less negative one for third births. We now turn to a hazard regression

analysis to see if the differences observed in the transitions to the second and third births remain after controlling for differences in the ages at which the different education groups reach the first and second births.

ESTIMATION OF HAZARD REGRESSION MODELS

The foregoing descriptive results emphasize two components of changes in the association between education and completed fertility across cohorts, and between men and women: 1) changes in the probabilities of going on to have a second and third birth and 2) changes in the start of childbearing and related differences in the proportions remaining childless. To further understand the nature of these changes over time and the differences between men and women we use a hazard regression model estimated with aML software (Lillard and Panis 2000). But before describing the technical aspects of the model, we first discuss the need to use this model.

First, consider the transition from the first to the second birth, contrasting women with a low level of education to women with a high level of education. Women with a higher level of education have their first birth at a later age, and hence start their exposure to the risk of a second birth at a time in their life when unmeasured factors such as fecundity, interests in non-childrearing activities and other issues might result in their having a lower probability of having that second birth independent of any continuing relationship with education. In this section we use a hazard modelling approach to control for the age at first birth effect so that we can see the remaining relationship between education and the hazard of having a second birth. The same argument extends to the transition from the second to the third birth.

A common approach has been to estimate separate models for second and third births, and include duration since last previous birth and current age (or age at last birth) along with education. Doing so, the effect of, for example, college education on second births reflects the difference in second-birth rates between women with college education and those with only compulsory education who are of the same age and had their first child the same number of years earlier. However, this difference is partly due to selection on the better educated having children early for whatever reason.[2] By controlling for this selectivity, one gets a purer estimate of how education affects the parity transition in focus. To do this we model first-, second- and third-birth rates jointly and include a common unobserved factor, further specified below (Woolridge 2002).[3] A few recent studies have shown that this technique gives markedly different results, and for example can wipe out positive education effects appearing in models estimated separately for second or higher-order births (Kravdal 2001; Kreyenfeld 2002). This difference in the results appeared with these data also, but we only report the results from model that takes selection into account.

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[2] This idea may need some explanation. Those with high education tend to have their first child later than those with low education, for a number of reasons discussed above. Let us say that their average ages at first birth are 30 and 25 years, respectively. When a model is estimated separately for second births and includes age and duration since last previous birth, one essentially compares the second-birth rates of women with different educational level who have the same age, let us say 27 years, and whose first child have the same age, let us say 2 years. Those with high education in this group have had a much earlier first birth (25) than usual for their educational category (30). Therefore, they must have had a higher score on some fertility-promoting factors than what is usual for women with this educational category, while this is not the case for those with low education, who are more "on time". Perhaps the fecundity (a factor that probably varies little by education) in the sub-group of better educated women is above average, perhaps they are relatively strongly care-oriented, or perhaps they have weaker work-career ambitions than what is usual in their educational category. These characteristics may also tend to push their second- and higher-order birth rates up, and the intention of our modelling approach is to get rid of that contribution to arrive at a more reasonable measure of how education affects these birth rates. See Kravdal (2001,2002) for further discussion of such selection issues.

[3] An alternative approach might have been to include age at previous birth compared to the average for that educational category, as done by Hoem (1996) and Hoem et al. (2001)

Detailed specification

Individuals are followed from January the year the woman or man turned 18, or the time of the previous birth, and it is censored at age 39. Those who did not live in Norway at age 39 are excluded. The estimation is done separately for five-year birth cohorts, and for each sex.

The first-birth rate is assumed to depend on age. Second- and third-birth rates are, in addition, assumed to depend on duration since the previous birth.[4] Besides, there is a covariate vector **X** that includes the educational level achieved by age 39. In the first-birth equation, **X** also includes interactions between education and age. This is because several studies have shown that first-birth rates for women who end up with high education tend to be particularly low in the teens and low twenties, while they may be higher than those for the less educated at a later age (e.g. Kravdal 1994; Rindfuss et al 2007; Santow and Bracher 2001). Although part of this pattern may be a result of selection, there are also reasons to believe that other mechanisms are involved, so that the interactions should be included even in this model that takes account of selection.

More specifically, this is the model that we estimate:

$$\log h^{(1)} = \beta_0^{(1)} + \boldsymbol{\beta}_1^{(1)} \mathbf{A}(a, v_1, v_2, v_3, v_4, v_5) + \boldsymbol{\beta}_3^{(1)} \mathbf{X} + \delta$$

$$\log h^{(2)} = \beta_0^{(2)} + \boldsymbol{\beta}_1^{(2)} \mathbf{A'}(a, v_1', v_2', v_3', v_4') + \boldsymbol{\beta}_2^{(2)} \mathbf{D}(d, z_1, z_2, z_3, z_4) + \boldsymbol{\beta}_3^{(2)} \mathbf{X} + \delta$$

$$\log h^{(3)} = \beta_0^{(3)} + \boldsymbol{\beta}_1^{(3)} \mathbf{A'}(a, v_2', v_3', v_4') + \boldsymbol{\beta}_2^{(3)} \mathbf{D}(d, z_1, z_2, z_3, z_4) + \boldsymbol{\beta}_3^{(3)} \mathbf{X} + \delta$$

[4] All three variables "current age", "duration since previous birth", and "age at previous birth" are likely to affect the birth rates, in addition to picking up certain background factors. However, only two of them can be included, and it turned out that education effects were insensitive to the choice.

where h is a birth rate and $^{(1)}$, $^{(2)}$ and $^{(3)}$ are symbols for first, second and third births, respectively. In these equations, β_0 is a constant, and **A** is a piecewise linear spline transformation of age, with nodes v_1, v_2, v_3, v_4 and v_5 at the end of the years when the person turned 20, 23, 27, 32, and 37, respectively.[5] $\boldsymbol{\beta}_1$ is the corresponding row vector of associations. Also **A'**, which was included for second and third births, is an age spline, with nodes at 20 (only for second births), 25, 30 and 35 years, and **D** is a duration spline with four nodes at 2, 4, 6 and 8 years. Unfortunately, the data did not include information about factors that may be important determinants of both education and fertility, i.e. contributing to a spurious relationship between the two. We return to this issue in the conclusion.

δ is an unobserved factor assumed to be drawn independently for each person at the start of the reproductive period and sticking to that person through age 39. Further, the distribution from which it is drawn is assumed to be normal, with zero mean and a variance to be estimated (it turns out to be in the range 0.5-1). This distribution is approximated by 20 support points, which is sufficient (because 40 points always gave the same results; 5 points would have been enough in many models, though).[6] Separate modelling of each parity transition corresponds to excluding δ.

One might assume interactions between education and duration since last birth to be relevant for second and third births. One group might, for example, end up with just as many

[5] More precisely, the spline was defined as a column vector whose transpose is $\mathbf{A}^t = (\min[a,v_1], \max[0,\min[a-v_1, v_2-v_1]], \max[0,\min[a-v_2,v_3-v_2]], \max[0,\min[a-v_3,v_4-v_3]], \max[0,\min[a-v_4,v_5-v_4]], \max[0,a-v_5])$

[6] For each person, aML calculates a joint likelihhood for the outcomes, conditional on different values of the heterogeneity factor. Next, it is integrated numerically over these values and summed over all individuals. The resulting likelihood is the one to be maximized. The values of the heterogeneity factor (the so-called support points) and the corresponding weights are chosen to approximate the normal distribution (the so-called Gauss-Hermite approximation). The maximization procedure is based on analytical first derivatives and the BHHH search algorithm.

second births as another group (same "quantum"), but have these births earlier or later (different "spacing"). Additional effects of education at durations below 3 years or after 6 years were included in some models, but there were no clear patterns in these interactions, and the education effects had the same sign at all durations. Therefore, we felt comfortable ignoring such interactions in our final models.

Hazard regression results

The association of education at age 39 with second- and third-birth rates are shown in Table 6 for both sexes. With the large number of cases from these register data, the standard errors are very small. To save space, but to still provide the reader with an indication of their size, the standard errors are only shown for the youngest cohort. (Tables showing all the coefficients from the model can be obtained from the authors.)

For women, the education association with second- and third-birth rates is negative, most markedly for the oldest cohorts and diminishing for the younger cohorts. Generally, both second- and third-birth rates differed quite little by education among those born after 1955. It should be noted, though, that in cohorts as far back as 1950, women with college education had significantly higher third-birth rates than those with *secondary education*, who showed the lowest third-birth rates.

The association of education with second- and third-birth rates is generally less negative for men than for women, and are positive for the more recent cohorts. Most importantly, for those born after 1950, all educational categories showed higher second- and third-births rates than the men with only compulsory level, and those with the highest education showed the highest birth rates. Negative associations with education were seen for

older cohorts, in accordance with the less positive or more negative gradients in the corresponding parity progression ratios.

(Table 6 about here)

DISCUSSION AND CONCLUSION

To summarize, there have been marked changes in the association between fertility and education across these 1940 to 1964 cohorts, as well as large differences between men and women. Among women, the inverse relationship between completed fertility and educational attainment at age 39 has weakened, as a result of a sharp decline among those with little education, relative stability among the middle groups and, in the small group with a Master's degree, there has actually been a slight increase. Among men, the relationship is the opposite: it is the more highly educated who have the most children, and this pattern has gradually become more pronounced over time.

These trends are largely the result of gradually less negative relationships between education and second- and third-birth progression ratios among women, while the corresponding relationships among men have become more positive. There has been less change with respect to childlessness. Women's childlessness has always been positively related to their education, while the opposite is the case among men

Using a hazard regression approach, we have shown that there is a relationship between education and both the second- and third-birth rates beyond the fact that the better educated have a higher age at first birth. This "net effect" of education on higher-order birth rates is negative for women, but has become steadily weaker. For men, the net effect has turned from negative to positive (i.e. the relatively high parity progression ratios for better

educated men in the youngest cohorts result from positive net effect of education on higher-order birth rates that outweighs the impact of a higher age at first birth).

Why differences between sexes?

As discussed in the beginning of the paper, education can operate through multiple mechanisms, some contributing to higher fertility and others to lower fertility. Given that parenthood is expected to have less impact on men's role conflict with work or study than women's, it is not surprising that negative contributions are more dominant for women than for men, both with respect to first births and higher-order births.

The idea that a mother-work role conflict contributes to a negative relationship between education and fertility is based on the assumption that better-educated women have the highest wage potential. Moreover, the importance of these higher opportunity costs of childbearing are assumed to outweigh any fertility stimulating effect of their higher purchasing power once they return to work following childbirth. For men, it is typically only this latter "income effect" that is relevant. It is possible that the positive relationships that we observe for men are partly a result of a higher purchasing power among the better educated that is not completely offset by higher investments per child.

With respect to the knowledge component of educational attainment, there might be a higher correlation for women than men between educational attainment and the knowledge of aspects of modern contraception. As a result, women's education might be more important in minimizing contraceptive failure. While a logical possibility, we do not think differential knowledge by education and sex is a major explanation for the observed patterns.

Additionally, it is possible that educational differences in partnership formation differ across the sexes, with special relevance for first births. The importance of this is difficult to

assess because of the ambiguous causality (a stable partnership increases the chance of having a child and a birth may trigger marriage) and because we only have data on formal marriages. However, it is worth noting that, among women born in the 1940s[7], the proportion ever-married decreased with increasing education (appendix table A2), just as one would expect from neo-classical economic ideas about specialization. A different pattern is found for men. In addition to displaying lower childlessness than the less educated, the better educated men have also been more inclined to marry. This pattern accords well with the traditional picture of men as the main providers, and with the idea that there also is a non-economic value of (both men's and women's) education in a relationship.

Further, the relationship between women's education and their fertility is not only a result of the impact of their own education, but also that better-educated women tend to be married to or live with better-educated men (e.g. Schwartz and Mare, 2005), and that the partner's education affects fertility as well. Conversely, the relationship for men partly reflects the educational distribution of their partners and the impact of their partners' education. Given positive partnership educational homogeny, the independent net effects of women's education are probably more negative than indicated by our estimates, while those of men's education are less negative or more positive.

While there is a tendency for well-educated women to partner with well-educated men, one should also note that there is substantial and increasing, educational heterogamy in Norway. This is important because, as pointed out above, sex differences in the education-fertility relationship would be impossible in a hypothetical situation where everyone has a partner and there is complete educational partner homogeny. To illustrate the degree of heterogamy, we took the first child of each woman and compared her education with the

[7] For this discussion we focus on the earlier cohorts because cohabitation was less important then.

father's education. Across all cohorts, only 38% of the mothers and fathers of first-borns have the same level of education, and this figure has declined from 41% for the earliest cohort to 36% for the most recent. Further, the percentage of parents with the father having more education than the mother has also declined. Correspondingly, the percentage of parents of first-born children with the mother having higher educational attainment than the father has increased monotonically from 19% for the 1940-44 cohort to 30% for the 1960-64 cohort. In considering these trends, we note that there are only five educational categories with some being quite broad. In each of the cohorts, for approximately one in five of the parent couples, their educational attainment differs by two or more educational categories.

Why changes over time?

The marked change in the relationship between education and completed fertility across female cohorts, resulting, in particular, from the weaker negative relationship of education with the second- and third-birth rates, is consistent with changes in Norway that reduced the incompatibility between work and child rearing. High-quality, subsidized child care has become more widely available, with opening hours that accommodate parents who have full-time jobs. Paid parental leave benefits have been expanded and the right to part-time employment has increased. All of these trends have combined to reduce, but certainly not eliminate, the incompatibility between the mother and worker roles. This means that the wage-dependent opportunity costs have diminished, and child care costs, which vary less with education in the Norwegian system, become more prominent.

Changes in partnering, including marrying, is another potentially relevant factor, related to changes in women's opportunities. While we do not have data on trends in partnering more broadly defined, the trend in marriage is that higher educated women used to

be less likely to ever marry (appendix table A2). This educational difference in the likelihood of marriage has decreased, perhaps because the earnings potential of wives has become a more important factor in the constellation of factors influencing partner choice. So, the trend may, to some extent, reflect that better educated women have become relatively more likely to marry or form a long-term relationship with a man, and then go on to have one or more children.

Finally, for women, an additional possible explanation is that the better educated born in the 1940s may have had more knowledge of and more positive attitudes towards modern contraception, and such knowledge differentials by education declined for the younger cohorts. While this is a possibility, we do not think it is a major part of the temporal changes for women in the association between education and fertility.

For men, the potential explanations for the trend, an emergence of a modest positive relationship, are less clear. One possibility, given the stronger relationship between men's education and the proportion ever-married, is that, over time, better educated men are seen as more attractive partners. This might be a result of increasing income returns to education. To our knowledge, however, such a development is not documented for Norway (a paper by Raaum (1999) showed stability from 1980 to 1995), in spite of globalization trends and outsourcing of various low-status jobs to other countries. It might also be a result of a higher income being considered as more and more important in a relationship, or for parenthood, or that other correlates of high education, such as being an interesting conversation partner or contributing more to the work around the house, have become increasingly appreciated (partly because the women have more economic opportunities themselves and can afford to take such issues into account). In principle, the trend for men may also be related in a complex way to changes that have affected women: better educated men tend to have better educated partners, which means that the less pronounced negative effect of women's education across cohorts

will make any positive contribution from men's education more visible, but at the same time there have been changes in the degree of homogamy.

Limitations

This paper argues that the potential effects of education on fertility in low fertility countries are complex. We show that the education and fertility relationship has been changing over time in Norway, and that it is quite different for men and women. But, for a number of reasons, we cannot draw strong conclusions about the causal effects of education from our results. One issue is that a person's education is a result of his or her individual resources and interests, family background and various community characteristics, all of which could also affect fertility. Such factors are not picked up by the heterogeneity term in the hazard models.[8] For the more recent cohorts, we estimated a model comparable to those in Table 6, but including also the person's parents' education, whether the parents were married when the person was age 16, the number of births the person's mother had, and the logarithm of the population size of the municipality where the person lived at age 16. Including or excluding these control variables did not appreciably alter the education coefficients. While reassuring, there are of course also many other potential confounders, and the result need not extrapolate backwards to the older cohorts, for which these control variables could not be included (given when the Norwegian registers were initiated).

It is also important to consider the possibility that the factors behind the entry into various educational categories may have changed over time. For example, when there is a general expansion of education, whether fuelled by wealth, supportive policies and/or

[8] As explained above, the unobserved factor was defined to be uncorrelated with completed education at the start of the reproductive process.

changing requirements in the labor market, the diminishing group of people with only compulsory education are likely to be progressively recruited from the most socially disadvantaged groups. Put differently, the lower relative fertility for men in this category may be partly a result of the increasingly select background of them, in addition to the other mechanisms mentioned. Such problems related to unobserved background factors do not only affect this study, of course, but also other investigations of the fertility-education relationship.[9]

Another issue is that the observed education-fertility relationship may be partly produced by reverse causality. To see this, remember that we only have educational attainment for men and women at age 39. While some may have obtained a high education because they avoided having a child in order to complete their education, others may have dropped out of school earlier than planned because they had a child or were pregnant. This reverse causality possibility is an issue that has received considerable attention in the U.S., especially with respect to adolescent childbearing (e.g. Geronimus and Korenman 1993; Hoffman et al. 1993; Hofferth et al. 2001). Because women typically are more involved in the day to day care of infants and young children, we expect that this type of reverse causality is stronger for women than for men. And programs that allow young mothers to complete their education may well have weakened its effect over time. Thus, reverse causality may explain some of the patterns and trends that we have seen.

Looking forward

[9] The problem is less pronounced in some recent analyses that have been based on "natural experiments" to identify education effects; see e.g. the study on school reforms and health by Arendt (2005) or the paper on educational differences in the timing of fertility by Skirbekk et al. (2004).

To the extent that changes in the education-fertility relationship across cohorts have been driven by policies and ideologies that make it easier for mothers of young children to work or be a student, we see no reason to expect the trends for women to be broken soon. Those now in the midst of their reproductive years have experienced an even more family-friendly environment than those who have completed their childbearing. In fact, it is not impossible that we will even see a *positive* education-fertility relationship for women. As argued above, the better educated may have jobs that make it easier to resume employment soon after birth, so perhaps they will actually incur *lower* opportunity costs than the less educated. In addition, there may be other stimulating effects, though not necessarily more stimulating than in the past: the better educated contribute more to the family income beyond the peak childbearing years (i.e. the possibly positive "income effect"), and one may speculate whether they have partners who are more involved in housework and after-job child care. (In Norway, ever stronger attempts are being made to encourage father's involvement by reserving some of the parental leave for him, but the educational differences in the response to this are not known.)

To what extent is the development that we have seen for recent Norwegian cohorts likely to be found in other developed countries? We can only offer informed speculation on this question. The changes and patterns seen in Norway have occurred within a national context that likely influenced such changes. Some aspects of the Norwegian context can be found in most developed countries and others in only a few. The rapid expansion of educational attainment, especially for women (c.f., Table 1), has also taken place in other developed countries albeit with differing magnitudes. In Norway, this increase in educational attainment for women has been coupled with a national ideology that emphasizes equality, and, in particular, gender equality: Women should have the same opportunities as men to work and to do so with diminished conflict with rearing children. Guided by this ideology, and facilitated by the high standard of living Norway has enjoyed for the past few decades,

there have been steady improvements in paid parental leave packages available to mothers (and fathers) and increases in the availability of high quality, convenient, child care. We expect that both the ideology of gender equality and the policies implemented in Norway to promote gender equality have been important in reducing the educational differentials for women, and perhaps influencing the emergence of a positive differential among men, and other countries with similar features may/will have experienced similar trends.

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Table 1. Distribution of education at age 39, by birth cohort and sex (per cent)

WOMEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	33	26	20	14	8
Lower-secondary (11-12 years)	44	46	45	42	23
Higher-secondary (13 years)	5	7	9	13	24
Some college (14-17 years)	15	18	23	27	30
Higher degree (18+ years)	1	2	2	3	5
Total[a]	100	100	100	100	100
Number of women	114933	147284	140647	144586	143699

MEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	28	23	19	15	10
Lower-secondary (11-12 years)	32	32	34	29	24
Higher-secondary (13 years)	15	17	17	25	35
Some college (14-17 years)	16	18	21	23	23
Higher degree (18+ years)	8	8	9	8	8
Total[a]	100	100	100	100	100
Number of men	120728	155342	146984	149856	148929

[a] Totals may not add to 100 because of rounding error.

Table 2. Average number of births at age 39, by education, birth cohort and sex

WOMEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	2.46	2.31	2.14	2.10	2.16
Lower-secondary (11-12 years)	2.28	2.12	2.03	2.02	2.09
Higher-secondary (13 years)	1.99	1.94	1.91	1.91	2.01
Some college (14-17 years)	2.05	1.96	1.94	1.96	1.96
Higher degree (18+ years)	1.65	1.64	1.72	1.77	1.78
Total[a]	2.27	2.11	2.01	1.99	2.02
MEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	1.98	1.83	1.73	1.65	1.63
Lower-secondary (11-12 years)	2.08	1.92	1.81	1.71	1.62
Higher-secondary (13 years)	2.02	1.91	1.87	1.84	1.80
Some college (14-17 years)	1.99	1.88	1.83	1.79	1.74
Higher degree (18+ years)	2.06	1.92	1.92	1.87	1.80
Total[a]	2.01	1.88	1.81	1.75	1.72

[a] Includes about 1% with unknown or less than compulsory education.

Table 3. Proportion childless at age 39, by education, birth cohort and sex (per cent)

WOMEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	10.9	9.3	9.7	11.1	11.6
Lower-secondary (11-12 years)	10.5	9.6	10.4	12.2	11.7
Higher-secondary (13 years)	14.2	12.0	12.6	14.0	12.1
Some college (14-17 years)	14.8	14.0	14.4	15.5	15.2
Higher degree (18+ years)	24.9	21.4	20.9	21.2	20.4
Total[a]	12.1	11.0	11.9	13.7	13.4
MEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	21.9	21.5	23.0	25.4	25.9
Lower-secondary (11-12 years)	15.9	17.0	19.7	24.0	27.0
Higher-secondary (13 years)	14.0	14.9	16.7	18.7	19.8
Some college (14-17 years)	14.3	15.4	17.9	20.6	22.3
Higher degree (18+ years)	13.1	14.5	16.6	19.9	21.0
Total[a]	17.4	17.5	19.4	22.1	23.1

[a] Includes about 1% with unknown or less than compulsory education.

Table 4. Proportion of women with at least one child who had also had a second child by age 39, by education, birth cohort and sex (per cent)

WOMEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	88.9	87.5	84.3	83.0	83.0
Lower-secondary (11-12 years)	88.3	86.6	84.6	83.8	83.7
Higher-secondary (13 years)	85.0	83.6	81.8	81.9	83.9
Some college (14-17 years)	87.6	85.5	83.6	84.2	84.3
Higher degree (18+ years)	81.2	78.4	78.8	81.7	82.2
Total[a]	88.1	86.3	83.9	83.4	83.8
MEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	85.5	82.5	79.3	76.6	75.6
Lower-secondary (11-12 years)	87.6	84.7	82.0	79.7	77.2
Higher-secondary (13 years)	86.6	84.3	83.0	82.3	80.9
Some college (14-17 years)	86.2	83.5	82.9	82.2	81.3
Higher degree (18+ years)	87.1	84.7	83.8	84.8	83.2
Total[a]	86.5	83.9	82.0	80.9	79.8

[a] Includes about 1% with unknown or less than compulsory education.

Table 5. Proportion of women with at least two children who had also had a third child by age 39, by education, birth cohort and sex (per cent)

WOMEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	60.9	52.6	44.8	45.8	50.4
Lower-secondary (11-12 years)	52.2	42.4	38.7	42.7	46.7
Higher-secondary (13 years)	43.8	35.3	35.6	39.4	41.8
Some college (14-17 years)	46.2	39.2	40.3	45.2	45.0
Higher degree (18+ years)	37.7	32.7	38.8	42.9	42.1
Total[a]	53.7	44.0	40.1	43.4	45.2
MEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	53.7	45.0	42.0	43.7	43.6
Lower-secondary (11-12 years)	49.0	42.0	40.2	42.7	43.6
Higher-secondary (13 years)	43.1	37.5	38.4	41.8	41.9
Some college (14-17 years)	41.6	36.9	39.2	42.8	42.2
Higher degree (18+ years)	42.5	38.7	43.7	46.2	44.2
Total[a]	48	41	40	43	43

[a] Includes about 1% with unknown,or less than compulsory education.

Table 6. Effects of educational level at age 39 on second- and third-birth rates among Norwegian women and men.

WOMEN						
	1940-44	1945-49	1950-54	1955-59	1960-64	
Second birth						
Educational level						
Compulsory (10 years)	0	0	0	0	0	
Lower-secondary (11-12 years)	-0.12****	-0.19****	-0.14****	-0.06****	-0.01	(0.02)
Higher-secondary (13 years)	-0.45****	-0.49****	-0.36****	-0.20****	-0.07****	(0.02)
Some college (14-17 years)	-0.39****	-0.49****	-0.37****	-0.13****	-0.08****	(0.02)
Higher degree (18+ years)	-0.77****	-0.91****	-0.64****	-0.23****	-0.17****	(0.03)
Third birth						
Educational level						
Compulsory (10 years)	0	0	0	0	0	
Lower-secondary (11-12 years)	-0.27****	-0.34****	-0.21****	-0.07****	-0.04*	(0.02)
Higher-secondary (13 years)	-0.63****	-0.65****	-0.37****	-0.20****	-0.18****	(0.02)
Some college (14-17 years)	-0.46****	-0.45****	-0.15****	0.07***	-0.03	(0.03)
Higher degree (18+ years)	-0.81****	-0.74****	-0.12**	0.11**	0.01	(0.04)
MEN						
	1940-44	1945-49	1950-54	1955-59	1960-64	
Second birth						
Educational level						
Compulsory (10 years)	0	0	0	0	0	
Lower-secondary (11-12 years)	0.05****	0.05****	0.08****	0.12****	0.10****	(0.02)
Higher-secondary (13 years)	-0.06****	-0.03**	0.12****	0.25****	0.30****	(0.02)
Some college (14-17 years)	-0.18****	-0.13****	0.03*	0.24****	0.30****	(0.02)
Higher degree (18+ years)	-0.15****	-0.11****	0.13****	0.42****	0.43****	(0.02)
Third birth						
Educational level						
Compulsory (10 years)	0	0	0	0	0	
Lower-secondary (11-12 years)	-0.09****	-0.05****	-0.01	0.05**	0.07***	(0.02)
Higher-secondary (13 years)	-0.29****	-0.21****	-0.02	0.10****	0.09****	(0.02)
Some college (14-17 years)	-0.31****	-0.20****	0.00	0.17****	0.17****	(0.02)
Higher degree (18+ years)	-0.19****	-0.05**	0.25****	0.40****	0.36****	(0.02)

Effects on first-birth rates are not shown. Unknown or less than compulsory education was a separate group, for which estimates are not shown. The models also included age, duration since previous birth (only for second and third births), and an interaction between age and education (only for first births). This interaction was specified as one additional effect of education below age 25 and another additional effect above age 30. See text for further details.
* p<0.10; ** p< 0.05; *** p<0.01; **** p<0.001 (two-tailed test)

APPENDIX

Table A1. Average age at first birth among those who had become parents by age 39, by birth cohort and sex

WOMEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	22.1	21.7	21,5	21.7	22.4
Lower-secondary (11-12 years)	23.5	23.2	23.1	23.6	24.0
Higher-secondary (13 years)	24.8	24.6	24.5	25.3	25.6
Some college (14-17 years)	26.2	26.0	26.3	26.9	27.4
Higher degree (18+ years)	27.7	27.9	28.7	29.4	29.9
Total[a]	23.5	23.5	23.7	24.6	25.5
MEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	25.2	24.8	24.9	25.9	26.5
Lower-secondary (11-12 years)	25.6	25.3	25.7	26.6	27.1
Higher-secondary (13 years)	25.8	25.7	26.2	27.2	27.7
Some college (14-17 years)	26.9	27.0	27.6	28.7	29.3
Higher degree (18+ years)	28.0	28.1	28.9	29.7	30.4
Total[a]	25.9	25.8	26.3	27.4	28.0

[a] Includes about 1% with unknown or less than compulsory education.

Table A2. Proportion ever-married by age 39, by birth cohort and sex (per cent)

WOMEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	95.1	93.9	90.1	83.8	73.6
Lower-secondary (11-12 years)	94.6	93.8	90.3	83.6	74.8
Higher-secondary (13 years)	92.5	92.4	89.2	82.2	75.7
Some college (14-17 years)	90.5	89.7	86.8	81.3	74.5
Higher degree (18+ years)	83.1	83.7	81.4	77.8	71.2
Total[a]	93.5	92.4	89.0	82.4	74.5
MEN					
	1940-44	1945-49	1950-54	1955-59	1960-64
Educational level					
Compulsory (10 years)	83.8	82.0	75.9	66.0	54.8
Lower-secondary (11-12 years)	89.7	87.1	80.6	69.0	57.2
Higher-secondary (13 years)	91.6	89.8	84.5	76.1	67.0
Some college (14-17 years)	92.0	89.0	83.6	75.7	68.0
Higher degree (18+ years)	92.4	89.7	85.3	79.4	73.3
Total[a]	88.4	86.6	81.1	72.3	63.8

[a] Includes about 1% with unknown or less than compulsory education.