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Replication

Educational reproduction in Sweden: A replication of Skopek and Leopold 2020 using Swedish data

Vanessa Wittemann

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Educational reproduction in Sweden: A replication of Skopek and Leopold 2020 using Swedish data

Vanessa Wittemann[1]

Abstract

BACKGROUND
Intergenerational social mobility, or the inheritance of status characteristics, is well-studied in Sweden. However, it accounts for just one aspect of the process of intergenerational reproduction of social inequality. The role of socially stratified fertility in this process remains underexplored.

OBJECTIVE
I address the gap in knowledge by replicating the approach pioneered by Skopek and Leopold (2020) in the context of Germany in order to study the relative contributions of the mobility component vis-à-vis the fertility component in the educational reproduction of Swedish cohorts born between 1930 and 1950.

METHOD
The approach involves estimating several components of a stylized population renewal model using retrospective data and performing counterfactual simulations. I utilize data from the Swedish samples of the Generations and Gender Survey, the European Social Survey, and the Survey of Health, Ageing, and Retirement in Europe.

RESULTS
My findings for Sweden reveal a relatively strong degree of intergenerational transmission of educational attainment, increasing for men and decreasing for women, coupled with an overall weak but stable educational gradient in fertility. Educational reproduction in Sweden is thus mostly driven by the mobility component.

CONTRIBUTION
This is the first study to obtain prospective estimates of educational reproduction based on retrospective data and to explore the relative role of mobility vis-à-vis fertility in the process of intergenerational reproduction of social inequality in Sweden.

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1. Introduction

The case of Sweden is well-studied in intergenerational social mobility research, i.e., research that studies how one generation inherits various status characteristics from another. For example, parents' education is a considerable factor in determining the educational attainment of the child, no matter how it is measured (Jonsson 1993; Breen, Mood, and Jonsson 2016; Dribe and Helgertz 2016; Erikson 2016; Hällsten and Pfeffer 2017; Põder, Lauri, and Veski 2017; Hällsten and Thaning 2018).

Authors that have ranked countries according to the intergenerational influence of education have found different results. Chevalier, Denny, and McMahon (2003) categorize Sweden as a country where parents' educational level has a relatively low association with children's educational attainment, while in other studies Sweden is in the midfield of such rankings (Hertz et al. 2008; Pfeffer 2008; Van der Weide et al. 2021).

Moreover, a unique pattern of increasing mobility rates over time has been observed in Sweden (Shavit and Blossfeld 1993; Breen and Jonsson 2007). Previous literature has connected this either to educational expansion (Jonsson and Erikson 2000; Breen and Jonsson 2007; Breen 2010) and comprehensive school reforms in the 1950s and 1960s (Jonsson and Erikson 2000), or to institutional factors such as the educational system's degree of stratification (Pfeffer 2008; Bol and van de Werfhorst 2013). Other explanations focus on political elements, such as the domination of the Social Democratic Party and its political goal of equalizing opportunities and living conditions (Erikson and Goldthorpe 1992; Jonsson and Mills 1993), with high expenditure on early education and care and simultaneously high female labour force participation (Crettaz and Jacot 2014).

However, the research as cited above does not give a comprehensive view of the intergenerational reproduction of social inequality; i.e., the process whereby the structure of inequality in one generation is carried forward to the next one. A comprehensive view involves considering not only the rate of the inheritance of status characteristics but also the demographic aspect, i.e., fertility, which can also differ across educational levels. Following Song and Mare (2020), throughout the rest of this paper I will refer to these as the mobility and fertility components. Indeed, educational groups' differing fertility patterns determine the social stratification in the next generation. Individuals contribute to the educational stratification of the next generation not only by transmitting their (dis)advantage to their children but also through the different average numbers of children they produce. Thus, the probability difference between high- and low-educated individuals having a high-educated child is connected to their production of children in the first place. Conventional social mobility research based on retrospective data neglects the fertility aspect of reproduction because it conditions on fertility by default: it can only provide data on those who have become parents.

To quantify both the mobility and the fertility pathway of educational reproduction provides a richer account of the structural forces that shape wider structural changes, such as educational expansion. Expansion of educational opportunities and changing incentives for educational attainment are frequently connected to increasing enrolment (Craig 1981; Hannum et al. 2019). However, educational expansion is partly endogenous to demographic behaviour such as educationally stratified fertility, a mechanism which often remains neglected. Demographic processes can either suppress or reinforce educational expansion: it is suppressed if the greater capacity of higher-educated parents to enhance the educational attainment of their children is offset by their lower fertility compared to lower-educated parents, and it is reinforced if the social gradient in fertility is absent or positive. Adding demographic pathways to the study of the intergenerational transmission of education thus increases our understanding of educational expansion.

Addressing the trade-off between the fertility and mobility aspects of educational reproduction is also crucial with regard to the interplay of sibship size and educational reproduction. According to the resource dilution hypothesis (Blake 1981), larger sibship size can dilute parental resources relevant to status attainment, such as the time, money, and energy that parents have to invest in children (Dribe, Van Bavel, and Campbell 2012; Kolk and Hällsten 2017). Consequently, assuming a status-maintenance motive (Breen and Goldthorpe 1997), more ambitious higher-educated parents are incentivised to limit their fertility to enable optimal investment in their children's education. However, this incentive should be less pronounced in a context where status-maintenance objectives are more easily met, for example, by improved educational opportunities (Kolk and Hällsten 2017). Thus, in a context like Sweden where the educational system is flexible and less stratified than in other countries (Halldén 2008), parents should be less concerned about resource dilution and thus less incentivised to limit their fertility. However, whether this is related to change in the opportunities for social and demographic reproduction remains an open question, which this analysis addresses.

What is the role of fertility in the intergenerational reproduction of social inequality in Sweden, and how does it compare to that of mobility? To date there have only been a few prospective studies of educational reproduction in Sweden. Kolk and Hällsten (2017) investigate social and demographic pathways of reproduction in an explicit area in northern Sweden in a prospective manner, following individuals born between 1860–1879 and their descendants up to the year 2007. Although fertility shows a significant association with the educational composition of the descendants, socioeconomic background is also strongly related to educational attainment. However, this study is limited to a very specific time and region. Breen, Ermisch, and Helske (2019) analyse the educational reproduction of men and women born 1930–1950 in twelve European countries prospectively, taking differential fertility and assortative mating into account. However, a comparison of estimates which take demographic factors into account with those estimates that condition on parenthood shows that conditioning on parenthood overstates the degree parents transmit their education to their children (Breen, Ermisch, and Helske 2019). This difference is smaller in Sweden than in other countries. This study also has some limitations, the most important of which is that it is restricted to information about up to four children, which results in an underestimation of fertility, i.e., the demographic component. Furthermore, the analysis only mimics prospective panel data through biographic life-course data on respondents and their offspring and suffers from small sample sizes, which may lead to measurement errors resulting from recall problems and survival bias. Finally, Breen, Ermisch, and Helske do not consider that sibship size can mediate the extent of intergenerational transmission (i.e., interact with the mobility component in the process of intergenerational reproduction), which is yet another limitation which I overcome in my analysis by replicating the method of Skopek and Leopold. Additionally, and in contrast to Breen, Ermisch, and Helske (2019), my analysis is able to detect time trends by analysing different cohorts separately.

Not only educational mobility but also fertility patterns across educational groups are distinct in Sweden. Like other European countries, Sweden experienced a fertility decline around the turn of the 18th century (Hoem 2005), which peaked in the 1930s and was followed by a ‘baby boom’ between 1955–1965 (Sandström 2014). Thus, the cohorts contributing the most to this baby boom are those born between 1920–1940 (Van Bavel et al. 2018). However, even in the fertility decline, fertility rates in Sweden stayed relatively high compared to other European countries (Björklund 2006). Especially in comparison with West Germany, Hoem (2005) reports significantly higher total fertility rates (TFR) in Sweden. Unusually, in Sweden relatively high fertility is combined with relatively high female labour-market participation (Jalovaara et al. 2019).

Although several studies report a small negative gradient of fertility across educational groups (Hoem 2005; Björklund 2006; Andersson 2008; Sandström 2014; Van Bavel et al. 2018; Jalovaara et al. 2019; Nisén et al. 2021), this negative relationship is significantly less pronounced in Sweden than in West Germany (Hoem 2005) and other European countries (Björklund 2006). Additionally, the association between educational level and fertility declined across cohorts born between 1930 and 1950 (Björklund 2006; Sandström 2014). Educational differences in the level of childlessness decreased towards convergence for the cohorts born 1930–1950, a trend that was mainly driven by decreasing rates of childlessness among highly educated women (Sandström 2014). Jalovaara et al. (2019) find that for cohorts born after 1960 educational differences in rates of childlessness even reversed in Sweden. For these later-born women, lower education is associated on average with higher rates of childlessness. However, Dribe and Scalone (2014) find a U-shaped pattern of fertility stratification across occupational classes. Even though this pattern does not refer solely to education, educational achievement and occupational classes are highly connected (Groß 2000; Berggren 2010;

Blanden 2013). Thus, previous literature finds no clear educational gradient of fertility in Sweden. The absence of a negative educational fertility gradient makes quantifying the contribution of fertility vis-à-vis mobility in the process of intergenerational transmission of education especially interesting, because this potentially positive fertility gradient could be a driver of educational expansion.

Sweden also presents an interesting comparison to Germany with regard to a number of factors which might be related to intergenerational transmission. The two countries differ in their educational systems and the timing and extent of their educational expansion, which can be endogenous to educationally stratified fertility. Another relevant difference is the Swedish government's emphasis on a comprehensive welfare state with equalizing educational institutions versus a highly stratified and rigid educational system in Germany. These societal aspects are connected to both the degree of transmission and educational fertility patterns.

Based on these findings from previous studies, I hypothesize that compared to the mobility component, the role of the fertility component in the process of educational reproduction is small, or even absent. I also expect the fertility component in Sweden to be smaller than that found for Germany by Skopek and Leopold.

In this paper I aim to fill a gap by replicating the approach pioneered in the context of Germany by Skopek and Leopold (2020) and studying the relative contributions of the mobility versus fertility components in the educational reproduction of Swedish cohorts born between 1930 and 1950. I focus on education because the family-background factor has been found to matter most regarding social mobility in Sweden (Hällsten and Thaning 2018) and is also the most cross-nationally comparable. I estimate several components of a stylized population renewal model using retrospective data and performing counterfactual simulations. The data is taken from the Swedish samples of the Generations and Gender Survey, the European Social Survey, and the Survey of Health, Ageing, and Retirement in Europe.

The following section explains the method and describes the data used and how external fertility data is matched with the sample. The results are then discussed in three steps. First, trends in differential fertility across educational groups are outlined; second, trends in educational attainment and conventional retrospective estimates of educational mobility are illustrated, and third, fertility is considered and demographic and social pathways of educational reproduction are presented. The findings are then compared with those Skopek and Leopold (2020) found for Germany. I close with a general conclusion and discuss limitations and directions for further research.

2. Methodology and data

2.1 Modelling the role of fertility in educational reproduction

The approach of Skopek and Leopold is based on estimating several components of a stylized population renewal model. In the model the link between the educational distributions of two generations is given by the unconditional rate of educational reproduction (RER). It is unconditional in the sense of not conditioning on fertility. Socially stratified fertility is explicitly accounted for as an important mechanism in the reproduction process. More specifically, RER is the number of children attaining educational level j a person of educational level i is expected to produce, which can be described by the following equation:

$$r_{ji} = P(F = 0|I = i) \cdot 0 + (1 - P(F = 0|I = i)) \cdot \sum_{f>0} (P(F = f|F > 0, I = i) \cdot f \cdot P(J = j|I = i, F = f)) \tag{1}$$

In the equation, $P(F = 0|I = i)$ is the probability of remaining childless conditional on education, $P(F = f|F > 0, I = i)$ is the probability of having f children conditional on having children and education, and $P(J = j|I = i, F = f)$ is the probability that a child attains education j if parent's education is i and family size is f. Of the three, only the last one corresponds to the mobility component as retrieved by conventional intergenerational mobility research based on retrospective data. In turn, fertility exerts two types of effect on the rate of reproduction: (1) population-level effects, or literally the educational gradient of fertility, and (2) family-level effects, or the effect of family size on children's educational attainment (i.e., the effect of fertility on mobility).

2.2 Data

I analyse the educational reproduction of cohorts born between 1930–1950 prospectively by using the retrospective data of respondents and their parents. I adapt the technique of Skopek and Leopold (2020) by first defining the child population that descended from individuals born 1930–1950. I call this the 'anchor sample' because it serves as an anchor for reconstructing the parent generation born 1930–1950. By reconstructing this parent generation, I adjust for retrospective sampling bias by matching external fertility data – precisely, information on rates of childlessness – to the retrospective data.

To construct the anchor sample, I use data from the Swedish subsample of the Generations and Gender Survey (GGS), wave 1. These data were collected in 2012 and

2013 and comprise 9,688 individuals born between 1933 and 1994. The dataset contains information on the level of education of both respondents and parents. Furthermore, it provides data on respondents' sex, year of birth, number of siblings, mother's and father's year of birth, and whether the parents were born in Sweden.

As in Skopek and Leopold (2020), I assess education using a dichotomous measure of high vs. low education. However, instead of defining an upper-secondary degree (*Abitur*) as high, in this analysis every education level above secondary is defined as high. The reason for this is practical: regarding the respondents' parents, the GGS data does not distinguish between lower (ISCED level 2) and upper secondary education (ISCED level 3) or between post secondary not tertiary (ISCED level 4) and tertiary education (ISCED levels 5 and 6). This is also feasible because educational expansion started earlier in Sweden than in Germany and educational levels rose rapidly from the 1960s onwards, so that about 98% of students that finish compulsory education continue to upper secondary education (Halldén 2008; Tesching 2012), which is necessary for continuing to higher education (Bachelors degree and above). Additionally, in Sweden people who do not complete upper secondary education are able to apply for higher education if they meet certain criteria, for example, work experience (Tesching 2012). Thus, in Sweden completed secondary education is not connected to special advantages regarding later education or occupational career, whereas, in terms of payment and labour market prospects, tertiary education is (Berggren 2010).

This slightly different definition of higher education is likely to result in problems of right-censoring. The youngest respondents were 24 years old when the data was collected and so may not have completed higher education. According to Halldén (2008), following the predetermined education schedule in Sweden, individuals finish University College at age 21, a bachelor's degree at age 22, and a master's degree at age 24. Additionally, Gustafsson, Kenjoh, and Wetzels (2002) report the mean age that Swedish women born 1930–1950 finished higher education to be between 22 and 24 years. However, not everyone sticks to such schedules, and in Sweden it is possible to re-enter education at later ages (Tesching 2012). This will be discussed in detail in the Results section, but one should keep in mind that for descendants of the last cohort of parents, right-censoring in terms of education might be a problem and could distort results.

2.2.1 Defining the retrospective anchor sample

The anchor sample has to be representative of the generation that descended from individuals born 1930–1950 and thus includes individuals born between 1944–1988, assuming a minimum age of fertility of 14 years and maximum age of 38 years. This upper bound of fertility is rather young, but I adopt these boundaries to achieve results that are comparable to those of Skopek and Leopold (2020). Nevertheless, since the Swedish baby boom related to women born 1930–1950 was mainly driven by women under 30 (Sandström 2014), the conservative upper bound can partly be justified demographically.

I remove all respondents with missing information on one of the important variables and restrict the sample to individuals born 1944–1988, leaving a sample size of n = 6,844. Provided calibration weights are used to adjust for sample selection so that the sample is representative of people born 1944–1988 in Sweden. Table 1 presents descriptive statistics of the sample. The mean number of siblings is 2.3, so the data assume an average of at least 3 children per parent, which is higher than that suggested by demographic data on the average family size of cohorts born 1930–1950 (Sandström 2014). This causes retrospective sampling bias because in this sample each child is considered to have two unique parents, whereas in reality siblings share the same parents. An adjustment of this bias will be explained in the following section. See Figure A-1 in the Appendix for a visual summary of the distribution of the anchor sample and respondents' parents.

Table 1: Starting sample of respondents

Respondent						
	Birth year	Age	Number of siblings	High educated	Born in Sweden	
Mean	1966	46	2.3	0.41	0.82	
SD	13	13	1.9	0.49	0.38	
Min.	1944	23	0	0	0	
Max.	1988	69	23	1	1	
Retrospective information on parents						
	Mother			Father		
	Birth year	Born in Sweden	Higher educated	Birth year	Born in Sweden	Higher educated
Mean	1938	0.78	0.28	1935	0.78	0.28
SD	15	0.42	0.45	15	0.42	0.45
Min.	1898	0	0	1887	0	0
Max.	1972	1	1	1969	1	1

Next, to obtain a representative picture of the population that the target cohort C1 (individuals born between 1930–1950) has produced, I restrict the anchor sample to those whose parents were born between 1930 and 1950. I assume that parents in the target cohort C1 did not have children before 1944 or after 1988, as discussed above. Accordingly, my approach is to first approximate the population that descended from the target cohort and on this basis reconstruct a sampling frame of their parents, G1, which is the share of individuals in C1 who have become parents.

The third step is to define the anchor sample for G1 mothers and fathers separately. Only mothers and fathers who were born in Sweden and whose educational level is known are considered. Additionally, the samples of fathers and mothers are split into four nearly equidistant cohort groups: 1930–1935, 1936–1940, 1941–1945, and 1946–1950.

In total, this results in $2 \times 4 = 8$ anchor subsamples containing 4,645 anchor respondents. For an overview of the subsamples see Table A-1 in the Appendix.

2.2.2 Minimizing retrospective sampling bias

The anchor data is not representative of the entire cohort born 1930–1950 (C1) because they contain only those who have become parents (G1). Additionally, data on higher-parity parents are overrepresented, as the average number of siblings of anchor respondents illustrates. To adjust the sampling frame appropriately I use a method suggested by Song and Mare (2015) and applied by Skopek and Leopold (2020), which adjusts the retrospective anchor sample in two steps.

First, family size is accounted for, and second, the sample is adjusted for the proportion of childless individuals born 1930–1950. The first correction factor can be obtained by calculating weights for family size based on the information on anchor respondents' number of siblings. This allows adjusting for the over-representation of higher-parity parents. For a detailed calculation of the family-size weights see the Appendix section C4.

Second, I account for the fraction of childless individuals in C1 who so far are not represented in the sample. I impute the probability of remaining childless for the cohorts born between 1930–1950 using external fertility data. The probability of remaining childless is calculated separately for genders, cohorts, and education levels. To obtain more precise estimates of childlessness, data are pooled from the Swedish subsample of the European Social Survey (ESS), wave 3, conducted in 2006; the Swedish subsample of the Survey of Health, Ageing and Retirement in Europe (SHARE) wave 1, from 2004; and the Swedish subsample of the Generations and Gender Survey (GGS) wave 1, from 2012–2013. The data include information on education level, date of birth, childlessness, and country of birth. The GGS data sample is the same as used for the anchor sample but uses information from respondents born between 1933–1950 for the fertility data, while the anchor sample contains information from respondents born 1944–1988. These three data sources combined provide fertility information on N = 3,705 respondents born between 1930–1950. See Table A-2 in the Appendix for detailed information on the three surveys. I use a logistic regression model to estimate the probability of remaining childless. I calculate that probability separately for cohorts, genders, and educational levels and adjust for possible survey effects. For a detailed formula of the regression analysis see Appendix section C3. Finally, these probabilities of remaining childless are matched to the G1 sample based on cohort, level of education, and gender, depicted in covariate vector $\mathbf{X}$. The weights that account for retrospective sampling bias are then:

$$fw_k = w_k \cdot \frac{1}{1 - Pr(F = 0|\boldsymbol{X})} \tag{2}$$

Using these weights on the retrospective anchor sample yields marginal distributions of educational levels that are representative of the C1 population, including those without children. Additionally, based on the number of children obtained from the anchor sample and the childlessness rates it is possible to assess cohort fertility rates for men and women of different educational groups.

Table 2 presents estimation results for childlessness and cohort fertility across educational levels. The rates of childlessness differentiated by educational level allow estimating the main outcome of interest, the unconditional rates of educational reproduction of C1 (Equation 1). These unconditional RERs are calculated separately for genders, educational groups, and cohorts. Figure A-2 in the Appendix offers a visual overview of the population proportions and their offspring after the two adjustment steps.

2.3 Linking educational distributions between generations

Finally, educational distributions can be linked across generations, giving a prospective insight into educational reproduction via population renewal models (Mare and Maralani 2006; Kye and Mare 2012; Song and Mare 2015; Skopek and Leopold 2020). This is used to investigate how the educational distribution of the child generation would have changed in different scenarios. For a detailed description of the process of calculating population renewal models see Appendix section C-2. Additionally, I calculate seven different scenarios to assess the impact of differential fertility and different levels of educational transmission.

2.4 Decomposing fertility and mobility effects in educational reproduction

The model described in section 2.1 can be further used to estimate the relative contributions to educational reproduction of the fertility and the mobility components. For this, the differences in RERs between educational groups, i.e.,

$$\Delta^j = r_{ji} - r_{ji'} \, , \tag{3}$$

can be expressed as a linear combination of the fertility component (Δ_f^{j}) and the mobility component (Δ_m^{j}):

$$\Delta^j = \Delta_f^j + \Delta_m^j \tag{4}$$

To estimate the components of Δ^j, Skopek and Leopold propose the following strategy based on counterfactual simulations. First, Δ^j is calculated under two different scenarios: (1) assuming the high-educated have the fertility patterns of the low-educated and (2) assuming the low-educated have the fertility patterns of the high-educated. Δ_f^j is then simply the average of the difference between the factual Δ^j and each of the two simulated outcomes. Δ_m^j can be calculated analogously or retrieved from Equation 4 once Δ_f^j is known. The decomposition technique is described in detail in the original paper (Skopek and Leopold 2020).

3. Results

3.1 Trends in differential fertility

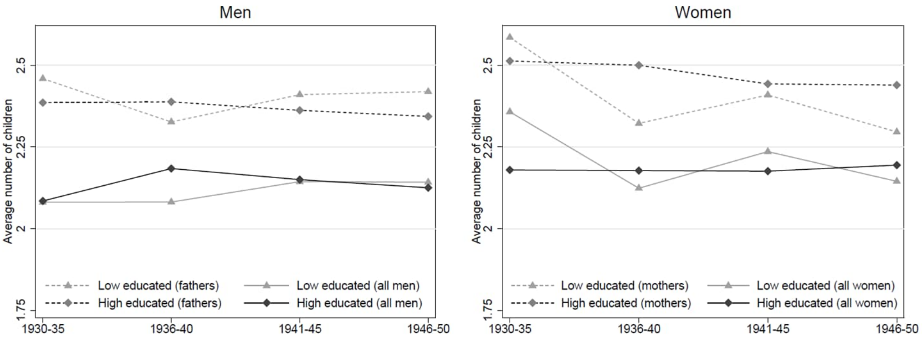
Table 2 reports childlessness rates, parents' average number of children (parental fertility rate, PFR), and the cohort fertility rate (CFR) by educational group, gender, and cohort. Figure 1 provides a visualization of this. In Figure A-3 in the Appendix I also compare my estimated fertility rates with those reported for Sweden in the Human Fertility Database. Cohort fertility rates of women, and in the later cohorts of men also, are slightly overestimated in my analysis, although the overall cohort trend matches that reported in the Human Fertility Database.

Table 2: Fertility behaviour by gender, education, and cohort

	Low-educated			High-educated		
Cohort	Childless (%)	PFR	CFR	Childless (%)	PFR	CFR
Men						
1930–1935	15.4	2.46	2.08	12.6	2.39	2.08
1936–1940	10.5	2.33	2.08	8.5	2.39	2.18
1941–1945	11.0	2.41	2.14	9	2.36	2.15
1946–1950	11.5	2.42	2.14	9.3	2.34	2.13
Women						
1930–1935	8.8	2.59	2.36	13.3	2.51	2.18
1936–1940	8.5	2.32	2.12	12.9	2.5	2.18
1941–1945	7.2	2.41	2.24	10.9	2.44	2.18
1946–1950	6.6	2.3	2.14	10	2.44	2.19

Note: PFR = parents' fertility rate (estimated from the anchor sample); CFR = Cohort fertility rate; CFR = (1-fraction of childless) × PFR. Data on childlessness is estimated from pooled external fertility data. The table presents predicted probabilities based on a logit model on pooled data. Data are weighted by normalized survey weights and are adjusted for survey effects (fixed at mean); see section C3 in the Appendix for a detailed model specification. Low-educated = upper-secondary degree or anything below; high-educated = anything above upper-secondary education.

Figure 1: Cohort fertility rate (CFR) conditional on parenthood (PFR) for men and women by educational level and cohort



Neither for men or women is fertility clearly stratified by education. High-educated fathers have a slightly lower fertility than low-educated fathers, except for the 1936–1940 cohort. However, when looking at all men this difference vanishes (again with the exception of the 1936–1940 cohort), which is a result of the higher childlessness rate of low-educated men (Table 2).

In the later-born cohorts, higher-educated mothers have a slightly higher fertility than low-educated mothers. This trend vanishes when all women are taken into account. Again, fertility differences are attributable to differences in childlessness across educational groups. High-educated women remain childless more often than low-educated women and, simultaneously, high-educated mothers have a slightly higher average number of children. However, for men and women the pattern of educationally stratified fertility is reversed.

Thus, trends in differential fertility are essentially different from those Skopek and Leopold (2020) report for Germany, where especially West German women clearly show educationally stratified fertility, with high-educated women having higher levels of childlessness. Additionally, and in line with previous investigations of fertility, rates of childlessness in West Germany, especially for highly educated men and women, are substantially higher than in Sweden (Hoem 2005). While in West Germany about 20% of high-educated individuals remain childless, in Sweden this proportion clusters around 10% (Table 2). The negative educational gradient of fertility in (West) Germany and the unclear pattern in Sweden is in line with previous research (e.g., see Sandström 2014).

These findings on educationally stratified fertility patterns support my expectation that educational differences in fertility are small or absent in Sweden.

3.2 Trends in educational attainment and offspring's educational mobility

Figure 2 displays the proportion of highly educated individuals across cohorts born 1930–1950 and their offspring by gender. Educational expansion is clearly visible in the trend of the parent generation as well as their offspring. Men born 1930–1935 show a higher fraction of high education than women of the same cohort. However, this pattern reverses with the following cohorts. The rise in the fraction of high-educated across cohorts is mirrored in the educational distribution of their offspring. Fifty-five percent of children descended from parents born 1946–1950 have high education, as opposed to only 37% of children from parents born 1930–1935. The fraction of high-educated offspring may be underestimated in the latest-born cohorts due to right-censoring: children born in 1988 or shortly before may not have finished their higher education at the time the data were collected. However, the pattern of educational expansion matches that in previous research (e.g., Dribe and Helgertz 2016). Thus, I assume that right-censoring does not crucially distort information on educational achievement in the data I use.

Although in Sweden the definition of higher education differs from that in Skopek and Leopold (2020), the fraction of high-educated individuals is substantially higher than in Germany, especially when comparing the parent generations. This is due to the different historical contexts of the two countries. In Sweden the dominance of the Social Democratic Party from the 1930s to the 1970s resulted in rapid social reforms, including educational expansion and equalisation (Dribe and Helgertz 2016). Germany introduced educational reforms in the 20th century, but due to the second world war and its aftermath, educational expansion began considerably later in both East and West Germany (Blossfeld, Blossfeld, and Blossfeld 2015).

Table 3 shows the probability of attaining higher education as a function of parents' education and family size, which represents conventional retrospective estimates of educational mobility. Effects are calculated separately for fathers' and mothers' offspring and cohorts using logistic regression models.

As Table 3 shows, parents' education is associated with offspring's probability of attaining high education across all cohorts and genders. There is no particular trend across cohorts. Thus, the chance of children of high-educated mothers or fathers attaining high education themselves is between 18% and 30% higher than for children with a low-educated mother or father. Compared to Germany, these family background effects are relatively small, given that in the analysis of Skopek and Leopold (2020) the probability difference of high-educated offspring by parents' education is up to 51%. This is in line with previous retrospective research on educational reproduction (e.g., Chevalier et al. 2003) and supports my expectation that educational inequality based on parents' education is lower in Sweden than in Germany. However, these are only retrospective results regarding educational reproduction, so they need to be re-examined prospectively.

In Sweden, family size is not related to children's probability of attaining higher education. For offspring of mothers born 1930–1935 and 1941–1945 each additional child in the family only reduced the chance of higher education by 4–5 percentage points. By contrast, in the analysis of Skopek and Leopold (2020), family size shows a substantial association with offspring's educational attainment. Thus, in Sweden, higher numbers of children do not per se reduce educational reproduction at the family level. This may be connected to the strong government focus on welfare in Sweden, which could compensate for parents' material and time resources (Kolk and Hällsten 2017).

Figure 2: Educational attainment of individuals born 1930–1950 and their offspring by gender

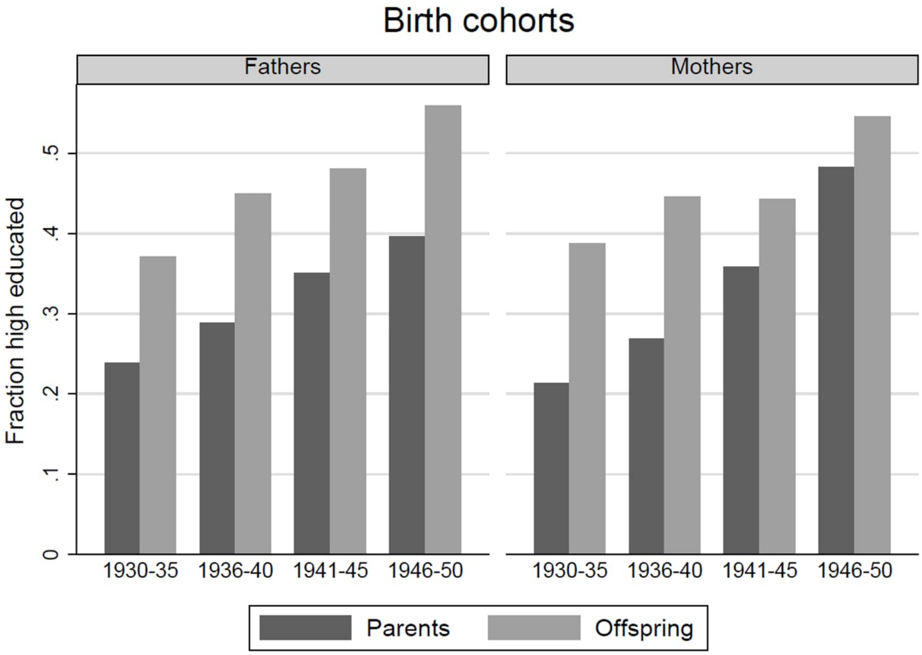


Table 3: Educational mobility: Probability of attaining higher education by parents' education and family size for offspring of fathers and mothers

	Offspring of fathers born			
Logit coefficients	1930–1935	1936–1940	1941–1945	1946–1950
Parent high-educated (ref. low)	1.086 [0.668,1.504]	0.747 [0.357,1.137]	1.211 [0.833,1.588]	1.285 [0.901,1.669]
Family size (siblings+1)	–0.065 [–0.214,0.0834]	–0.011 [–0.178,0.156]	–0.085 [–0.262,0.0922]	–0.036 [–0.215,0.142]
Intercept	–0.626 [–1.115,–0.137]	–0.43 [–0.932,0.0633]	–0.313 [–0.836,0.210]	–0.151 [–0.691,0.390]
Average marginal effects				
Parent high-educated (ref. lower)	0.260 [0.161,0.360]	0.184 [0.0896,0.279]	0.293 [0.207,0.379]	0.300 [0.219,0.381]
Family size (siblings+1)	–0.014 [–0.0470,0.0183]	–0.003 [–0.0426,0.0373]	–0.019 [–0.0599,0.0210]	–0.008 [–0.0484,0.0320]
N	527	520	559	557
McFadden's R2	0.041	0.021	0.059	0.066
	Offspring of mothers born			
Logit coefficients	1930–1935	1936–1940	1941–1945	1946–1950
Parent high-educated (ref. low)	1.337 [0.905,1.769]	0.902 [0.507,1.297]	0.955 [0.625,1.285]	1.050 [0.714,1.385]
Family size (siblings+1)	–0.172 [–0.300,–0.0439]	–0.141 [–0.303,0.0203]	–0.245 [–0.391,–0.0991]	0.014 [–0.136,0.163]
Intercept	–0.304 [–0.735,0.128]	–0.135 [–0.631,0.362]	0.008 [–0.442,0.458]	–0.345 [–0.804,0.114]
Average marginal effects				
Parent high-educated (ref. low)	0.317 [0.218,0.415]	0.220 [0.126,0.314]	0.228 [0.151,0.306]	0.254 [0.176,0.331]
Family size (siblings+1)	–0.037 [–0.0637,–0.00982]	–0.033 [–0.0705,0.00434]	–0.056 [–0.0882,–0.0234]	0.003 [–0.0314,0.0377]
N	609	539	691	643
McFadden's R2	0.061	0.033	0.048	0.048

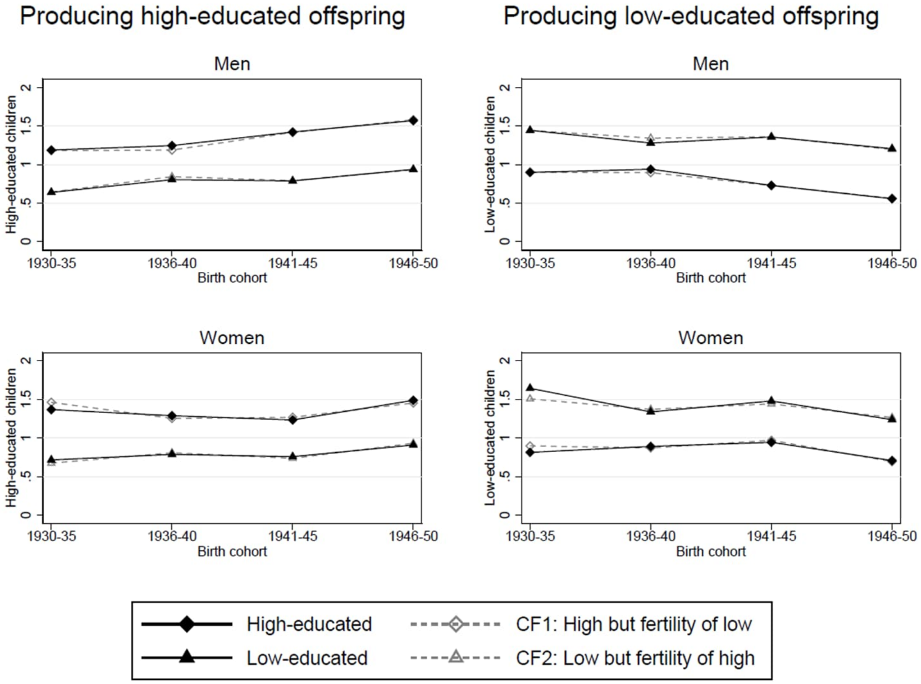
Note: Logistic regression using G2 fathers' offspring samples, mothers' offspring samples, and AME.
Confidence intervals in parentheses.

3.3 Trends in educational reproduction

Next, in the prospective model of educational reproduction, fertility enters the analysis. As described in the methods section, the fertility and mobility components can be decomposed and their relative importance in educational reproduction can be assessed. Figure 3 displays estimates of educational reproduction across cohorts and genders. The left panel shows estimated rates of producing high-educated offspring and the right panel estimated rates of producing low-educated offspring. Factual and hypothetical values (counterfactual rates) resulting from swapping the fertility behaviours of educational groups are displayed, with counterfactual rates visualized as dashes. For precise estimates see Appendix Table A-3.

Figure 4 shows the joint effects of educational reproduction – the difference between high- and low-educated individuals producing offspring with educational level *j* – and mobility effects. Mobility effects reflect the counterfactual difference in rates of educational reproduction if there are no differences in fertility across educational groups. The difference between the estimated joint effect and the mobility effect gives the fertility effect. Again, the left panel shows these effects for producing high-educated offspring while the right panel visualizes the effects for producing low-educated offspring. For precise estimates see Appendix Table A-4 and A-5.

Figure 3: Factual and counterfactual rates of educational reproduction



Note: Counterfactual 1 (CF1) and Counterfactual 2 (CF2) relate to counterfactual (hypothetical) rates of educational reproduction if the high-educated had the fertility behaviour of low-educated (CF1), and vice versa (CF2). For precise estimates see Table A-3 in the Appendix.

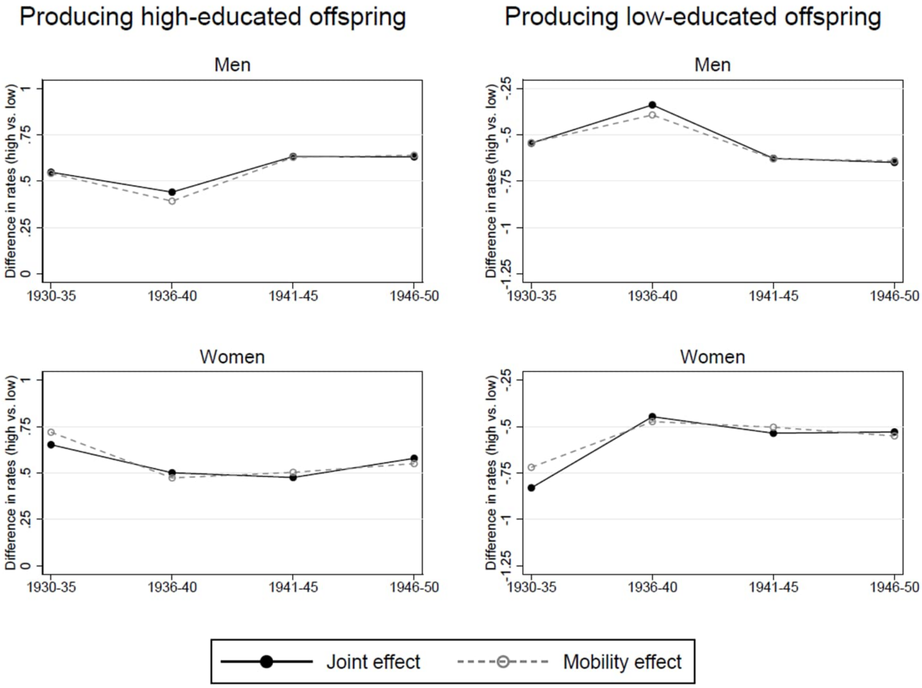
3.3.1 Men

The average number of high-educated children of low- and high-educated men increased slightly between the cohorts born 1930–1935 and 1945–1950. The average number of low-educated children decreased across the cohorts, reflecting educational expansion in the offspring generation. For example, educational differences in producing high-educated offspring, which are captured in the joint effect visualized in Figure 4, did not change substantially across cohorts. The educational gap in producing high-educated children is 0.55 for the cohort born 1930–1935 and 0.63 for the cohort born 1945–1950. Differential fertility does not play an important role in the process of educational reproduction in producing either high- or low-educated offspring. This is illustrated by the lines reflecting the mobility effect and the joint effect lying almost on top of each other (Figure 4). Skopek and Leopold (2020) also find that differential fertility does not significantly contribute to the educational reproduction of German men.

3.3.2 Women

The patterns of educational reproduction of women look similar to those of men. The average number of highly educated children increased slightly for high- and low-educated women, while the expected average number of low-educated children decreased for both educational groups (Figure 3). The difference between educational groups, however, remained rather stable. Counterfactual rates of educational reproduction are almost identical to factual rates, reflecting low educational differences in fertility. This is reflected in Figure 4, where the mobility effect almost equals the joint effect. Small differences between factual and counterfactual rates are observed only for the cohort born 1930–1935, which means that fertility is related to educational reproduction. The joint effect of producing high-educated offspring would be 10% larger for this cohort if fertility differences were absent (Appendix Table A-4). Thus, differential fertility slightly dampens the mobility effect on producing high-educated children for women born 1930–1935. However, this effect comes with high uncertainty and diminishes across later-born cohorts. Also, in the production of low-educated children, differential fertility is only notable for the cohort born 1930–1935. Here, differential fertility increases the joint effect by 13%, but this effect is not significant and diminishes across later-born cohorts.

Figure 4: Joint effect of educational reproduction (high–low) and mobility effect (joint–mobility = fertility effect)



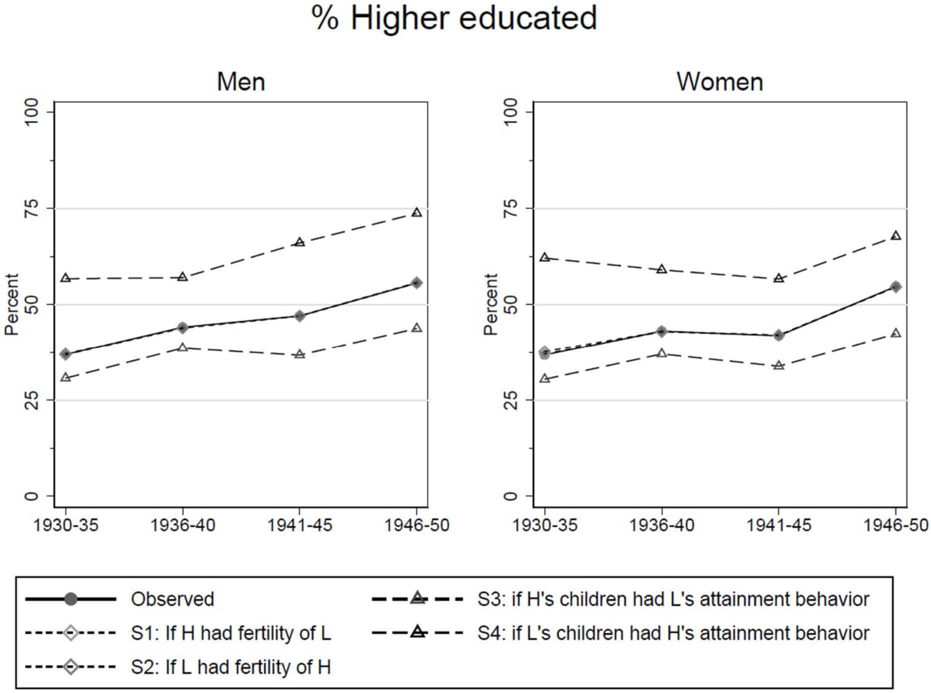
In Germany, stratified fertility was most important for West German women. The pattern is similar to that of the first cohort of Swedish women, with differential fertility damping the absolute difference between low- and high-educated women producing high-educated offspring (the joint effect) and increasing this effect for producing low-educated children. However, the fertility effects for West German women were much greater in magnitude than Swedish estimates and were associated with lower statistical uncertainty. The magnitude of the joint effect in Sweden resembles that found by Skopek and Leopold (2020) for East Germany, rather than West Germany. On average, in Sweden joint effects are closer to zero for both outcomes, reflecting smaller educational differences in the average number of high- and low-educated children. In Germany, differences in the rate of educational reproduction remained in East Germany and converged in West Germany. Skopek and Leopold (2020) attribute this partly to a general increase in educational opportunities through educational expansion and partly to a decline in fertility. Sweden also experienced comprehensive educational expansion, but differences in rates of educational reproduction remained rather stable. This supports the explanation of Shavit and Blossfeld (1993), who state that increasing educational mobility in Sweden is not connected to educational reforms. An additional explanation may be the timing of educational expansion, since in Sweden educational reforms were implemented in the first half of the 20th century (Halldén 2008). Thus, the equalizing effect of educational expansion may have affected cohorts born before 1930. In Sweden, in contrast to Germany, family size showed almost no substantial association with children's educational outcomes (Table 3). Thus, the initial decline in fertility, as well as the baby boom, were probably not associated with the degree of inequality of educational opportunity due to family size effects.

Overall, in Sweden the fertility component is vanishingly small and nonsignificant across cohorts and outcomes. Thus, the results of the analysis support my expectation that fertility effects play a smaller role (if any) in Sweden than in Germany and vanish for later-born cohorts.

3.4 Consequences of differential fertility in the offspring generation

The educational distribution in the offspring generation (G2) can be analysed using population renewal models. The proportion of highly educated individuals is simulated. Results are visualized in Figure 5 and Figure 6 (see Tables A-6, A-7, and A-8 in the Appendix for detailed statistics). Additionally, I compare observed values with seven hypothetical scenarios. In Figure 5, scenarios 1 and 2 swap the fertility behaviour of educational groups and scenarios 3 and 4 swap the mobility component of offspring of high- and low-educated parents. In Figure 6, scenario 5 assumes a strong educational transmission rate and scenario 6 assumes a strong negative fertility gradient. Finally, scenario 7 combines strong transmission rate with strong negative fertility gradient. For a hypothetical strong negative fertility gradient I followed Nisén et al. (2021) and assume low-educated individuals to have on average 1.5 more children than high-educated individuals. Analogically, to mimic a strong educational transmission I follow the work of Hertz et al. (2008) and assume the mobility component to be larger by 1 for individuals' probability of producing a child with the same educational level. The scenario analyses enable assessing the impact of differential fertility and different possibilities of educational attainment on the distribution of education in G2.

Figure 5: Scenario analyses of the effect of differential fertility and educational attainment behaviour on educational distribution

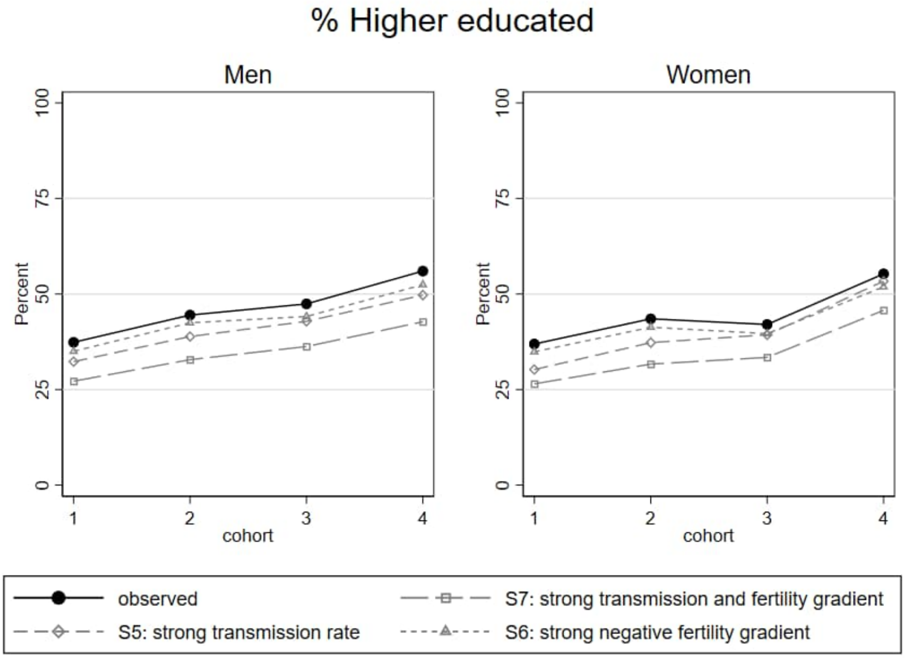


In line with Figure 3, where the counterfactual rates of educational reproduction almost equal the factual rates, in the scenario analyses swapping the fertility behaviour of educational groups does not change the educational distribution. This is because in Sweden fertility is not stratified across education as clearly as in Germany. Additionally, in Sweden the family-level effect of a higher number of children deteriorating educational opportunities is less pronounced, even almost invisible. Differences in the average number of high- (and low-) educated children are almost entirely due to the mobility component, which is inequality of opportunity. This is additionally illustrated in scenarios 3 and 4, which swap the educational attainment behaviour of children, causing substantial shifts in the educational distribution in G2. However, when looking at hypothetical scenarios 5 to 7, displayed in Figure 6, the hypothetical strong negative fertility gradient (scenario 6) reduces the percentage of high-educated people in G2. When assuming a high degree of educational transmission with the actual Swedish fertility gradient (scenario 5) the percentage of high-educated in G2 is more reduced.

However, as scenario 7 shows, a strong negative fertility gradient combined with a high degree of educational transmission inhibits educational expansion considerably.[2] Thus, in that scenario only 26% (women) to 27% (men) of the offspring would be high-educated, compared to 37% with the actual Swedish values (see Appendix Tables A-6, A-7, and A-8 for concrete values).

In summary, the scenario analyses confirm the earlier findings that in Sweden the link between the educational distributions of the two generations G1 and G2 is entirely due to the mobility component. By contrast, the fertility component contributes little to the educational reproduction of the cohorts under study. However, scenarios 5 to 7 emphasize the potential impact strongly educationally stratified fertility can have in specific contexts regarding educational expansion.

Figure 6: Scenario analyses of the effect of strong fertility gradient and educational transmission on educational distribution



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[2] Note that the educational distribution in C1 is unchanged.

4. Discussion

Based on previous research (Dribe and Scalone 2014; Sandström 2014; Jalovaara et al. 2019), I expected educational differences in fertility to be small or even absent for later-born cohorts, and to be substantially smaller in Sweden than in Germany. My analysis supports this, as I find no clear educational gradient for men or women. Furthermore, and in line with this finding and my expectations, differential fertility did not contribute substantially to the educational reproduction of Swedish individuals born 1930–1950. This demographic pathway of reproduction was only visible in the reproduction process of women born 1930–1935, where the higher fertility of low-educated women enhanced the reproduction of low-educated offspring and reduced the reproduction of high-educated offspring. However, in this cohort fertility only plays a negligible, statistically insignificant role. Simulations based on population renewal models further support the irrelevance of fertility concerning educational reproduction in Sweden. Swapping the fertility behaviour of educational groups yields no significant changes in the educational distribution of G2. However, scenarios with hypothetical strong negative fertility gradients demonstrate the potential impact stratified fertility can have in certain contexts. In Sweden family size also showed almost no substantial association with children's educational outcomes. This finding is the main contribution of my analysis, since the influence of differential fertility on educational reproduction is not yet well researched.

Regarding the mobility component, which captures inequality of educational opportunity, educational attainment is associated with parental educational level. This is in line with previous literature (e.g., Breen, Mood, and Jonsson 2016; Dribe and Helgertz 2016; Põder, Lauri, and Veski 2017; Hällsten and Thaning 2018). The gap between high- and low-educated individuals in the average number of high- or low-educated offspring (captured in the joint effect of educational reproduction) remained stable across cohorts. However, since the educational level of cohorts in C-1 rose substantially and high-educated individuals on average have more high-educated children, the proportion of high-educated individuals in G2 increased across parental cohorts. This analysis does not support the assumption of a compositional effect where higher-educated individuals are expected to show greater social fluidity and thus the replacement of older, less-educated cohorts by younger more-educated ones automatically increases the level of social mobility (Breen and Jonsson 2007). In my findings, younger cohorts show substantially higher proportions of high-educated individuals but the degree of educational inequality remains stable across cohorts.

Additionally, my analysis expands the findings of Breen, Ermisch, and Helske (2019), who investigate the difference between conditional and unconditional estimates of educational reproduction across European countries and find the difference between the two to be larger among high-educated women. Generally, estimates that condition on parenthood overstate the degree of educational reproduction. By closely examining the demographic and social pathways of reproduction in one country I gain new insight into the relevance of unconditional estimates and the relative role of fertility in the reproduction process. That fertility is not clearly stratified by education in Sweden and thus does not contribute decisively to the reproduction process of individuals born 1930–1950 is a new finding in the field. Additionally, applying Skopek and Leopold's (2020) research framework to the Swedish case allows comparison of the importance of social and demographic pathways regarding educational reproduction in Germany and Sweden.

Although Breen, Ermisch, and Helske’s (2019) analysis classifies Germany and Sweden in the same group, I found clear differences between these countries, especially regarding the educational gradient of fertility. In general, the effects of family background on education are substantially smaller in Sweden than in Germany. This finding is already well researched and my analysis reconfirms it. What is new is the analysis of the role of fertility in this process. First, in Sweden sibship size has no crucial association with educational reproduction, while in Germany each additional child in a family reduces the chances of attaining higher education. One reason for this might be that the association between parents’ and child’s education is stronger in Germany than in Sweden, so educational success in Germany is more dependent on parents’ resources. Parental resources dilute with more siblings, which is the mechanism behind the sibship-size effect (Downey 1995). Since in Sweden children’s educational attainment is less dependent on their parents’ education, parental resources should also play a minor role. Second, educationally stratified fertility is an important factor in the educational reproduction of West German women. Thus, the lower fertility of the high-educated restrains the amount of high-educated individuals in the offspring generation. As this analysis shows, this mechanism is not true for Sweden, where fertility is not clearly stratified across education and children’s education is less associated with parent’s education.

This work has its limitations. First, as already discussed, right-censoring due to necessary decisions regarding educational categories limits the findings on the latest-born offspring, since they may not have finished their educational career at the time the data was collected. However, as educational distribution in the offspring generation shows, the impact of this limitation on the estimates should be small. The second limitation is the insufficient quality of the external fertility data used in this analysis. As Figure A-3 in the Appendix shows, the calculated cohort fertility rates do not perfectly match those derived from the Human Fertility Database. One direction for further research could be replicating estimates based on the new method using register data which are prospective by nature, to assess how well the weighting procedure based on external fertility data adjusts for retrospective sampling bias. This is an advantage of applying the method to Sweden, a country which has suitable prospective data. A third limitation of this work is that it cannot be interpreted causally since only parental education is considered as a family-background factor. Although parental education is of great importance regarding social mobility, other factors such as parental social class and income are also important regarding the social pathway of reproduction (Erikson 2016; Lawrence and Breen 2016; Hällsten and Thaning 2018), and further demographic indicators such as assortative mating or the timing of childbirth are important regarding the demographic pathway of educational reproduction. Adding these indicators to the analysis could also be a direction for further research.

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Appendix

Figure A-1: Respondents and their parents

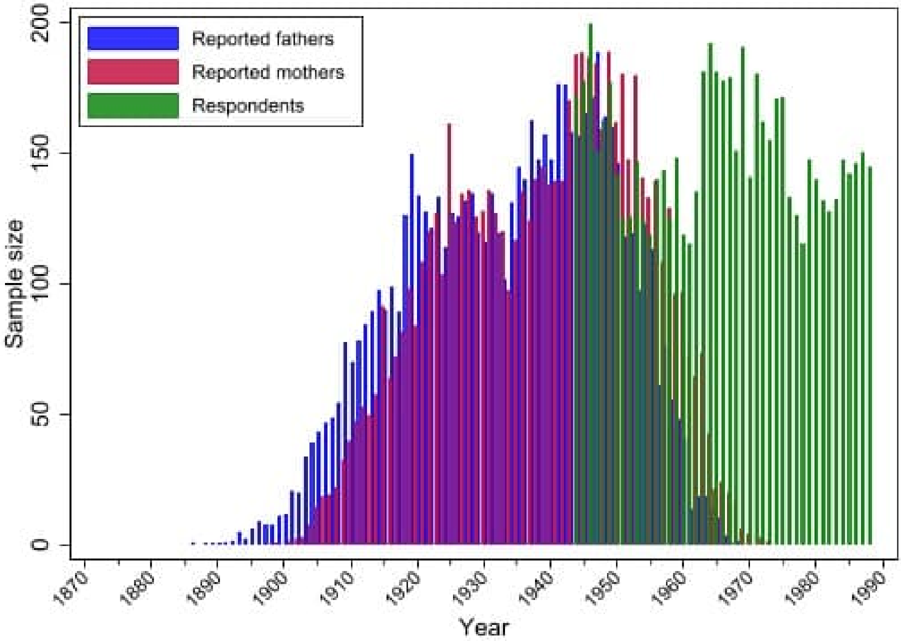

Figure A-2: Male and female target cohorts and their offspring after adjustment

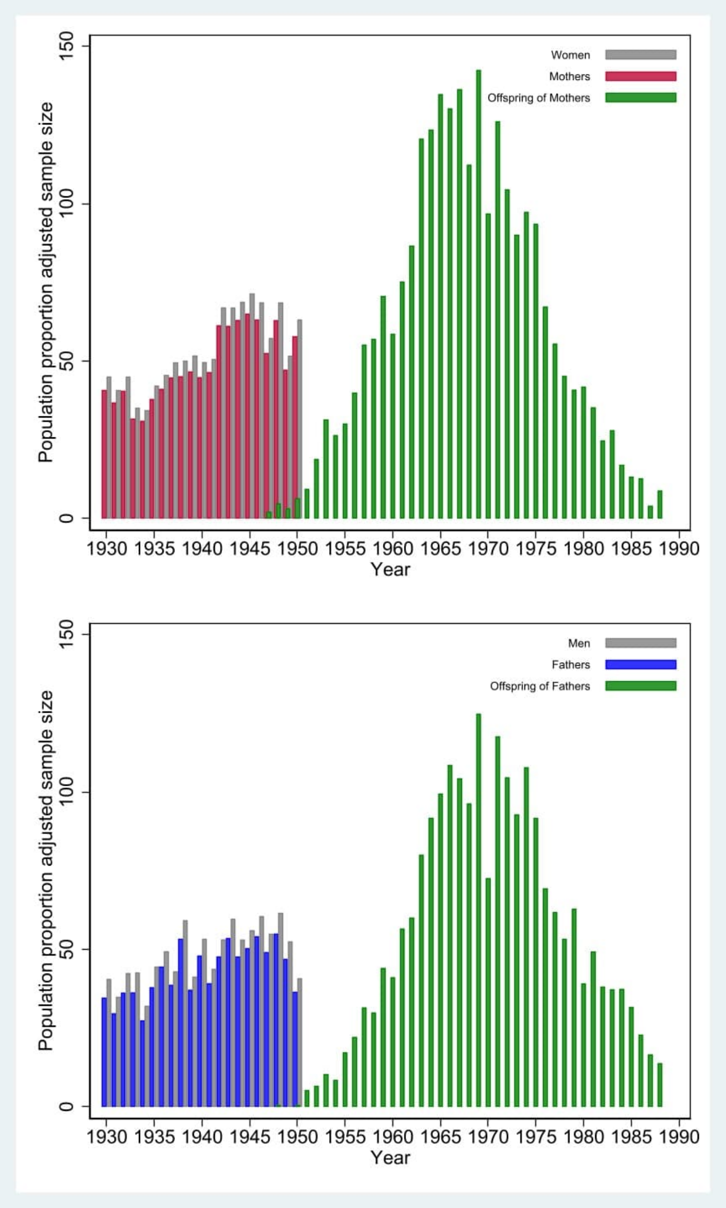

Figure A-3: Comparison of cohort fertility rates according to official data and adjusted retrospective data

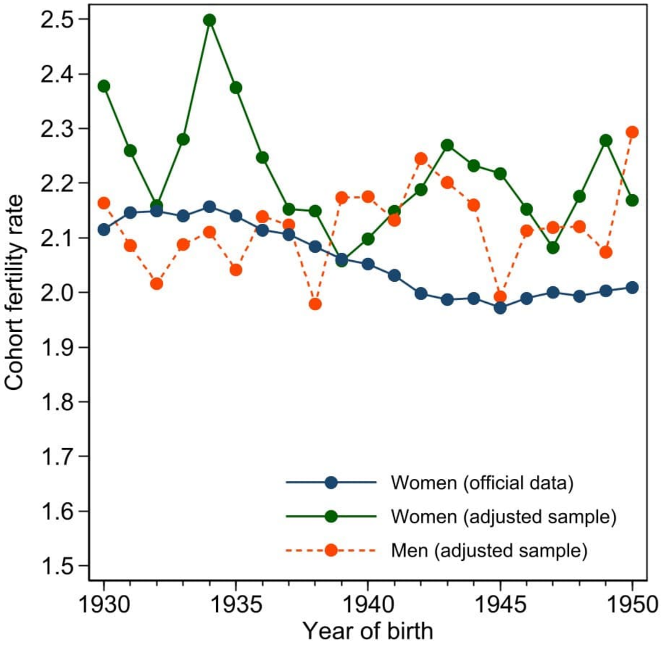

Table A-1: Offspring samples by gender of parent and parent birth cohort

		Offspring									
Parents			Year of birth						High-Educated Fraction	Number of siblings	
Gender	Birth Cohort	*N*	Mean	SD	Min.	P-5%	P-95%	Max.		Mean	SD
Fathers	1930–1935	527	1963	5.7	1948	1954	1974	1985	0.37	1.9	1.2
	1936–1940	520	1968	5.5	1955	1959	1977	1986	0.44	1.7	1.1
	1941–1945	559	1972	5.9	1960	1964	1984	1988	0.47	1.7	1
	1946–1950	557	1977	5.3	1965	1969	1986	1988	0.56	1.7	1
Mothers	1930–1935	609	1960	5.7	1947	1952	1970	1981	0.37	2.1	1.4
	1936–1940	539	1965	5	1953	1957	1974	1981	0.43	1.8	1.2
	1941–1945	691	1969	5.1	1957	1962	1978	1987	0.42	1.8	1.2
	1946–1950	643	1975	5.4	1962	1967	1985	1988	0.55	1.8	1.2
Total		4,645	1969	7.8	1947	1956	1983	1988	0.45	1.8	1.2

Note: High-educated = every educational level above upper secondary (ISCED levels 4–6). Data are weighted by cross-sectional weights.

Table A-2: Overview of pooled fertility data

Data	N	Variables Female %	Age Mean	Date of birth Mean	Min.	Max.	High-educated %	Childless %
ESS 2006	500	52	64	1942	1930	1950	28	9
GGS 2012	2,258	51	69	1943	1933	1950	31	8
SHARE 2004	947	50	63	1941	1930	1950	29	12

Note: Pooled data from ESS = European Social Survey, GGS = Generations and Gender Survey, SHARE = Survey of Health, Ageing and Retirement in Europe. High-educated = any educational level above upper-secondary (ISCED levels 4–6).

Table A-3.1: Rates of educational production (producing high-educated offspring) by gender and cohort

	Education	Low			High		
Gender	Cohort	C_H	95% conf. interval		C_H	95% conf. interval	
Women	1930–1935	0.715	.61705643	.81255621	1.367	1.1529588	1.5808096
	1936–1940	0.787	.68030269	.89320823	1.288	1.0933913	1.4822423
	1941–1945	0.757	.66020643	.85383927	1.233	1.0778898	1.387978
	1946–1950	0.908	.78312442	1.0337012	1.487	1.3483008	1.6261587
Men	1930–1935	0.638	.54198385	.73481034	1.187	.97277762	1.4012322
	1936–1940	0.804	.69364068	.91345013	1.245	1.0609161	1.4291154
	1941–1945	0.788	.6783609	.89694541	1.421	1.2571799	1.5843353
	1946–1950	0.937	.81589202	1.0583423	1.569	1.4109369	1.7266545

Note: C_L = Number of children attaining low education, C_H = Number of children attaining high education.

Table A-3.2: Rates of educational production (producing low-educated offspring) by gender and cohort

	Education	Low			High		
Gender	Cohort	C_L	95% conf. interval		C_L	95% conf. interval	
Women	1930–1935	1.643	1.5178355	1.767644	0.813	.599412	1.0262252
	1936–1940	1.337	1.2077114	1.4664468	0.890	.70178795	1.0783315
	1941–1945	1.479	1.3542348	1.6036267	0.943	.79499662	1.0911607
	1946–1950	1.237	1.1065782	1.3665533	0.707	.58265439	.83204073
Men	1930–1935	1.443	1.322096	1.5631705	0.898	.70759843	1.0881448
	1936–1940	1.278	1.1566549	1.3995965	0.939	.74426138	1.1338075
	1941–1945	1.356	1.2351307	1.4773751	0.729	.57022735	.88852106
	1946–1950	1.205	1.0739795	1.3361814	0.556	.42532652	.68759851

Note: C_L = Number of children attaining low education, C_H = Number of children attaining high education.

Table A-4: Joint effect, mobility effect, and fertility effect in producing high-educated offspring, by gender and cohort

Gender	Cohort	Joint effect			Mobility effect			Fertility effect			% Fertility
			95% Conf. Interval			95% Conf. Interval			95% Conf. Interval		
Women	1930–1935	0.652	.416	.887	0.719	.492	.946	–0.067	–.143	.008	–10.3
	1936–1940	0.502	.2794	.722	0.474	.268	.679	0.028	–.045	.101	5.5
	1941–1945	0.476	.293	.658	0.504	.329	.677	–0.028	–.077	.022	–5.8
	1946–1950	0.579	.391	.765	0.550	.380	.719	0.028	–.052	.108	4.9
Men	1930–1935	0.549	.314	.784	0.542	.330	.755	0.006	–.071	.083	1,2
	1936–1940	0.441	.227	.656	0.393	.190	.596	0.048	–.033	.130	11.0
	1941–1945	0.633	.436	.830	0.629	.443	.815	0.004	–.063	.071	0.6
	1946–1950	0.632	.433	.831	0.640	.462	.818	–0.008	–.092	.076	–1.3

Note: 95% confidence intervals are rounded to three digits.

Table A-5: Joint effect, mobility effect, and fertility effect in producing low-educated offspring, by gender and cohort

Gender	Cohort	Joint effect			Mobility effect			Fertility effect			% Fertility
			95% Conf. Interval			95% Conf. Interval			95% Conf. Interval		
Women	1930–1935	–0.830	–1.08	–.583	–0.719	–.946	–.492	–0.110	–.234	.013	13.3
	1936–1940	–0.447	–.675	–.219	–0.474	–.679	–.268	0.027	–.078	.131	–5.9
	1941–1945	–0.536	–.729	–.342	–0.504	–.677	–.330	–0.032	–.133	.068	6.0
	1946–1950	–0.529	–.709	–.349	–0.550	–.720	–.381	0.021	–.044	.086	–4.0
Men	1930–1935	–0.545	–.770	–.320	–0.542	–.754	–.330	–0.002	–.114	.109	0.5
	1936–1940	–0.339	–.569	–.110	–0.393	–.596	–.190	0.054	–.037	.145	–15.9
	1941–1945	–0.627	–.827	–.427	–0.629	–.815	–.443	0.002	–.074	.078	–0.4
	1946–1950	–0.649	–.834	–.463	–0.640	–.818	–.462	–0.009	–.072	.054	1.4

Note: 95% confidence intervals are rounded to three digits.

Table A-6: Projection values for scenario analysis (part 1)

		G2 – relative population size % (size G2 / size G1)					G2 – Educational distribution (% high educated)				
Gender	Cohort	Obs.	S1	S2	S3	S4	Obs.	S1	S2	S3	S4
Women	1930–1935	232	236	218	232	232	36.8	37.1	37.7	30,4	62.1
	1936–1940	241	212	218	214	214	43.1	43.0	43.0	37,1	59.1
	1941–1945	221	224	218	221	221	41.9	42.0	42.0	33,8	56.7
	1946–1950	217	214	219	217	217	54.8	54.6	54.6	42,4	67.7
Men	1930–1935	208	208	208	208	208	36.9	36.9	37.1	30.7	56.7
	1936–1940	211	208	218	211	211	44.1	43.9	43.9	38.6	57.0
	1941–1945	215	214	215	215	215	47.1	47.0	47.1	36.8	66.1
	1946–1950	214	214	213	214	214	55.6	55.6	55.7	43.8	73.8

Note: Obs. = Observed. Scenarios: S1 = high-educated had fertility of low-educated; S2 = low-educated had fertility of high-educated; S3 = children from high-educated parents had attainment behaviour of children from low-educated parents; S4 = children from low-educated parents had attainment behaviour of children from high-educated parents.

Table A-7: Projection values for scenario analysis (part 2)

		G2 – inequality of educational opportunity (log-odds ratio)					G2 – Inequality of educational opportunity (probability difference in attaining higher education)				
Gender	Cohort	Obs.	S1	S2	S3	S4	Obs.	S1	S2	S3	S4
Women	1930–1935	1.35	1.32	1.32	0.03	0.03	0.32	0.32	0.32	0.01	0.01
	1936–1940	0.90	0.90	0.90	0.00	0.00	0.22	0.22	0.22	0.00	0.00
	1941–1945	0.94	0.94	0.94	0.00	0.00	0.23	0.23	0.23	0.00	0.00
	1946–1950	1.05	1,05	1.05	0.00	0.00	0.25	0.25	0.25	0.00	0.00
Men	1930–1935	1.09	1.08	1.08	0.01	0.01	0.26	0.26	0.26	0.00	0.00
	1936–1940	0.75	0.75	0.75	0.00	0.00	0.18	0.18	0.18	0.00	0.00
	1941–1945	1.21	1.21	1.21	0.00	0.00	0.29	0.29	0.29	0.00	0.00
	1946–1950	1.29	1.28	1.28	0.00	0.00	0.30	0.30	0.30	0.00	0.00

Note: Obs. = Observed. Scenarios: S1 = high-educated had fertility of low-educated; S2 = low-educated had fertility of high-educated; S3 = children from high-educated parents had attainment behaviour of children from low-educated parents; S4 = children from low-educated parents had attainment behaviour of children from high-educated parents.

Table A-8: Projection values for scenario analysis (part 3, scenarios 5–7)

		G2 – Educational distribution (% high educated)		
Gender	Cohort	S5	S6	S7
Women	1930–1935	30.24	34.88	26.49
	1936–1940	37.28	41.31	31.66
	1941–1945	39.33	39.64	33.42
	1946–1950	53.36	51.88	45.73
Men	1930–1935	32.31	35.02	27.18
	1936–1940	38.88	42.47	32.82
	1941–1945	42.85	44.12	36.26
	1946–1950	49.72	52.43	42.74

Note: Obs. = Observed. Scenarios: S5 = if Sweden had a strong degree of educational transmission; S6 = if Sweden had a strong negative fertility gradient; S7 = if Sweden had both a strong degree of educational transmission and a strong negative fertility gradient.

Technical details

C1 Decomposition of rates of educational reproduction

The aim of modelling educational reproduction prospectively in this study is to be able to differentiate the calculated rates of educational reproduction (RER) into the component attributable to differential fertility across education (fertility component) and the component attributable to inequality of educational opportunity (mobility component). In order to be able to decompose the calculated RERs, the composition method applied by Skopek and Leopold (2020) is used. This method involves counterfactual rates of educational reproduction, calculated by swapping the fertility patterns of high- (h) and low- (l) educated individuals. For example, for the outcome of producing high-educated children (h), two factual rates of educational reproduction and two counterfactual rates are calculated, as shown in Table A-9.

Table A-9: Factual and counterfactual (hypothetical) rates of producing high-educated offspring by educational group

		Fertility behaviour of educational group	
		l	h
Educational group	l	r_{hl}	$r_{hl}^{F(h)}$
	h	$r_{hh}^{F(l)}$	r_{hh}

These rates are calculated using Equation (1) (see manuscript). Thus, r_{hl} and r_{hh} denote rates of low- and high-educated individuals respectively producing high-educated children. $r_{hh}^{F(l)}$ indicates the counterfactual rate for high-educated individuals producing high-educated children if they had the fertility of low-educated individuals, and $r_{hl}^{F(h)}$ denotes the hypothetical RER of low-educated individuals producing high-educated offspring if they had the fertility of high-educated individuals. Using Equation (1), the counterfactual RER can be written as follows:

$$\begin{aligned} r_{hl}^{F(h)} \triangleq r_{j=h,i=l}^{F(i=h)} &= (1 - P(F = 0|\boldsymbol{I} = \boldsymbol{h})) \\ &\cdot \sum_{f>0} (P(F = f|F > 0, \boldsymbol{I} = \boldsymbol{h}) \cdot f \\ &\cdot P(J = h|I = l, F = f)) \end{aligned} \tag{C1.1}$$

and

$$\begin{aligned} r_{hh}^{F(l)} \triangleq r_{j=h,i=h}^{F(i=l)} &= (1 - P(F = 0|\boldsymbol{I} = \boldsymbol{l})) \\ &\cdot \sum_{f>0} (P(F = f|F > 0, \boldsymbol{I} = \boldsymbol{l}) \cdot f \\ &\cdot P(J = h|I = h, F = f)) \end{aligned} \tag{C1.2}$$

The parts where fertility behaviour is swapped across educational groups is presented in bold. When the factual and the counterfactual RERs are calculated, the joint effect of educational reproduction can be disassembled into a fertility and a mobility component. For example, the joint effect of producing high-educated offspring is the difference between high- and low-educated individuals in producing high-educated offspring:

$$\Delta^{h} = r_{hh} - r_{hl} \tag{C1.3}$$

This joint effect includes the part of the difference which is attributable to differential fertility as well as the part which is attributable to differences in educational opportunity. Thus, the joint effect can be written as

$$\Delta^{h} = \Delta_{f}^{h} + \Delta_{m}^{h} \tag{C1.4}$$

Since Δ^{h} is known, only one of the two components needs to be derived. In order to calculate Δ_{f}^{h}, two questions have to be considered. First, what would the joint effect be if high-educated individuals had the fertility of low-educated individuals? This can be expressed as follows:

$$\Delta'^{h} = r_{hh}^{F(l)} - r_{hl} \tag{C1.5}$$

Second, what would be the joint effect be if low-educated individuals had the fertility of high-educated individuals? This is written as

$$\Delta''^{h} = r_{hh} - r_{hl}^{F(h)} \tag{C1.6}$$

The difference between the actual joint effect and the first counterfactual effect (Δ'^{h}) is then:

$$\Delta^{h} - \Delta'^{h} = (r_{hh} - r_{hl}) - \left(r_{hh}^{F(l)} - r_{hl}\right) = r_{hh} - r_{hh}^{F(l)} \tag{C1.7}$$

and between the actual joint effect and the second counterfactual joint effect is

$$\Delta^{h} - \Delta''^{h} = (r_{hh} - r_{hl}) - \left(r_{hh} - r_{hl}^{F(h)}\right) = r_{hl}^{F(l)} - r_{hl} \tag{C1.8}$$

The results of Equations C1.7 and C1.8 represent different viewpoints and can differ numerically. Consequently, the average of C1.7 and C1.8 is used to calculate the fertility component, which then is:

$$\Delta_{f}^{h} = \frac{1}{2}(r_{hl}^{F(h)} - r_{hl} + r_{hh} - r_{hh}^{F(l)} \tag{C1.9}$$

If educational groups do not differ in their fertility behaviour, the fertility component Δ_{f}^{h} is zero. If the fertility of high- (F_{h}) and low- (F_{l}) educated individuals in C1 is known, calculating the production rate of the alternative outcome (low-educated offspring) is straightforward. The sum of the fertility of high- and low-educated individuals in C1 is the average number of all children that individuals are expected to have. Since the total number of children equals the sum of high- and low-educated children,

$$F_{l} = r_{ll} + r_{hl} = r_{lh}^{F(l)} + r_{hh}^{F(l)} \tag{C1.10}$$

and

$$F_h = r_{lh} + r_{hh} = r_{ll}^{F(h)} + r_{hl}^{F(h)} \tag{C1.11}$$

Table A-10 reports the reproduction rates of producing low-educated offspring, which can all be calculated based on the rates of producing high-educated offspring and the fertility across educational groups.

Table A-10: Factual and counterfactual (hypothetical) rates of producing low-educated offspring, by educational group

		Fertility behaviour of educational group	
		l	h
Educational group	l	$r_{ll} = F_l - r_{hl}$	$r_{ll}^{F(h)} = F_h - r_{hl}^{F(h)}$
	h	$r_{lh}^{F(l)} = F_l - r_{hh}^{F(l)}$	$r_{lh} = F_h - r_{hh}$

The values of the joint effect of producing high-educated offspring and low-educated offspring are not necessarily equal in direction and magnitude. Thus, the absolute value of the mobility component is identical for both outcomes with reversed signs: $\Delta_m^h = -\Delta_m^l$. For a formal proof, see the Appendix of Skopek and Leopold (2020). The absolute value of the fertility component can differ for the outcome of high- and low-educated children but the value of the two fertility components adds up to the difference in fertility across educational groups:

$$F_h - F_l = \Delta_f^h + \Delta_f^l \tag{C1.12}$$

Again, for a formal proof, see the online Appendix of (Skopek and Leopold 2020).

C2 Population renewal models and mobility tables

Population renewal models based on estimates of rates of educational reproduction enable the construction of the educational mobility table from G2's perspective. If G2 denotes the progeny of C1, the number of children in G2 attaining educational level j with a parent with educational level i is given by

$$N_{ji}^{G2} = N_i^{C1} \cdot r_{ji} \tag{C2.1}$$

and the total number of children in G2 with educational level j is denoted as

$$N_{j.}^{G2} = N_{i}^{C1} \cdot r_{ji} + N_{i'}^{C1} \cdot r_{ji'} \ . \tag{C2.2}$$

Thus, the total number of children in G2 is given by

$$N^{G2} = N_{j.}^{G2} + N_{j'.}^{G2} \tag{C2.3}$$

Since educational levels in this study are either high (h) or low (l), the mobility table for G2 is:

Table A-11: Mobility table of offspring population G2

		G2 education		
		Low	High	Total
G1 (parent) education	Low	$N_l^{C1} \cdot r_{ll}$	$N_l^{C1} \cdot r_{hl}$	$N_{.l}^{G2} = N_l^{C1} \cdot F_l$
	High	$N_h^{C1} \cdot r_{lh}$	$N_h^{C1} \cdot r_{hh}$	$N_{.h}^{G2} = N_h^{C1} \cdot F_h$
	Total	$N_{l.}^{G2}$	$N_{h.}^{G2}$	N^{G2}

This table is used to calculate four scenarios and how they change (1) the relative population size (% G2/G1):

$$100 \times \frac{N^{G2}}{N^{C1}} = 100 \times \frac{N_l^{C1} \cdot F_l + N_h^{C1} \cdot F_h}{N^{C1}}, \tag{C2.4}$$

(2) the percentage of high-educated in G2 (educational distribution in G2):

$$100 \times \frac{N_{h.}^{G2}}{N^{G2}} \tag{C2.5}$$

and (3) inequality of educational opportunity:

$$ln(OR) = ln\left(\frac{N_h^{C1} \cdot r_{hh} \Big/ N_h^{C1} \cdot r_{lh}}{N_l^{C1} \cdot r_{hl} \Big/ N_l^{C1} \cdot r_{ll}}\right) \tag{C2.6}$$

Accordingly, inequality in educational opportunity is expressed by the log of the odds ratio of attaining high education for children of parents with different educational levels.

C3 Logit model for predicting levels of childlessness

The following specification is used to estimate levels of childlessness based on pooled fertility data:

$$\begin{aligned} logit(Pr(f = 0|X)) &= \alpha + \beta_1 C_{36-40} + \beta_2 C_{41-45} + \beta_3 C_{46-50} + \beta_4 E_H \\ &+ \beta_5 G_{female} + \beta_6 C_{36-40} G_{female} + \beta_7 C_{41-45} G_{female} \\ &+ \beta_8 C_{46-50} G_{female} + \beta_9 E_H G_{female} + I_{data^i} \end{aligned} \quad (5)$$

with dummies for birth cohorts (*C*), a dummy for high- versus low-education (*E*), a dummy for gender (*G*), and a vector of dummy variables controlling for survey effects (*I*).

C4 Family-size weights

The family-size weights are calculated as follows:

$$w_k = \frac{1}{f_k} \quad (6)$$

where k is an enumerator for respondents and f refers to the family size of the respondents, which is the number of siblings plus the respondent: $f_k = sibl_k + 1$. After these family-size weights are applied, the number of children of the G1 parents is disconnected from the probability of being included in the anchor sample, thus producing prospective pseudo-data on G1.

To demonstrate that the proposed weighting procedure effectively adjusts for over-representation of higher-parity parents in the anchor sample, G1's educational reproduction rate (Equation 1) is calculated in two steps. First, the children's probability of attaining educational level j given the parents' educational level i and the family size f [$\Pr(J = j|I = i, F = f_k)$] is calculated on the unweighted G2 sample using a logistic regression model. Second, the conditional prospective educational reproduction rate (Equation 1) is calculated by:

$$\begin{aligned} \hat{r}_{ji|f>0} &= \frac{1}{\sum_k^{n_i} w_k} \sum_k^{n_i} (w_k \cdot f_k \cdot Pr(J = j|I = i, F = F_k)) \\ &= \frac{1}{\sum_k^{n_i} w_k} \sum_k^{n_i} Pr(J = j|I = i, F = f_k), \end{aligned} \quad (7)$$

where n_i is the number of respondents with educational level i. Since the denominator of the mean expression equals the sum of the family-size weights instead of the sum of the respondents, reweighting effectively adjusts for over-representation of higher-parity parents in G1.