INVEST

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The pattern of educational inequality -
The contribution of family background on levels of education over time and across four countries

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ABSTRACT

This article analyses the pattern of inequality across levels of education and its evolution over time from a cross-national comparative perspective. We employ a previously disregarded approach of sibling correlations to measure how the contribution of the total family background differs across achieved levels of education. We compare successive birth cohorts in Finland, Sweden, Germany, and the U.S. between 1990 and 2015. We further analyze the extent to which the total contribution of parental background is accounted for by observed parental education. Our results indicate a pattern in which sibling similarity is strongest in the lowest and the highest levels of education in all studied countries. Changes over time were more pronounced in the Nordics and in educational levels other than the lowest. Observed parental education played a less notable role than expected, indicating that using only parental education ignores a substantial portion of the total influence of family background.

INTRODUCTION

The role of education as one of the driving forces behind social reproduction has attracted the attention of social stratification scholars for decades. A large volume of research has assessed how family background and educational attainment are interconnected (for reviews, see Björklund and Salvanes, 2011; Breen and Jonsson, 2005). Most of these studies have analyzed the resemblance in education between parents and their offspring, or used other indicators of socio-economic background, namely occupation or income, to evaluate the extent to which social background is associated with attained level of education.

However, measuring family background by different observable indicators of socio-economic and demographic factors has its limitations. Even though an extensive set of different dimensions of parental background are included in these analyses, many aspects of family background remain unmeasured. To overcome this limitation, sibling correlations can be used as an analytical tool to estimate the "total" effect of the family background. Sibling similarity measures the amount of variation in educational attainment that is explained by characteristics that siblings share. Thus, it reflects not only the measurable, but also the unmeasurable aspects of family background, such as family values and norms, shared genetic endowment, along with other shared factors such as neighborhood characteristics. An increasing number of studies have applied sibling correlations to measure the contribution of family background on educational attainment (Björklund and Jäntti, 2012; Grätz et al. 2019; Jencks et al. 1972; Marks and Mooi-Reci, 2016; Sieben et al., 2001; Sieben and Graaf, 2003).

While some of the previous research applying sibling correlations has considered differences between societies and over time, previous studies have disregarded differences between levels of education. Even though providing a single indicator for socioeconomic inheritance across the whole educational distribution by period in a society has its advantages, the approach nonetheless makes it difficult to draw conclusions about the role of institutional differences. This is because educational institutions and potential changes made to them are usually specific to certain levels of education, and are only identifiable when each educational level is studied separately.

In this study we investigate how the total contribution of family background on educational attainment changes over time across different levels of education by employing longitudinal data with sibling linkages. Our empirical strategy entails analyzing sibling similarities in education in Finland, Sweden, Germany, and the U.S. between 1990 and 2015. Unlike previous studies, we estimate sibling similarity in educational attainment at different levels of education separately. This allows us to describe the social selection patterns at each level in a more detailed manner. It can be

expected that the mechanisms involved vary by the level of education. Moreover, examining how sibling similarities specific to each level of education evolve over time and between countries contributes to our understanding about the contextual features that shape patterns of educational inequalities. We may by these means uncover cross-country differences which have previously gone unnoticed. We also distinguish the extent to which the total contribution of family background is accounted for by observed parental education. Observed parental education may contribute by a different magnitude between educational levels, across countries, and over time. Incorporating an analysis of observed parental education into the analysis of sibling correlations makes it possible to compare the relative importance of unobserved and observed aspects of family background.

BACKGROUND

The effect of family background on education

Family background differences in educational attainment stem from advantaged resources and living conditions of affluent families. Parents may intentionally invest in their children in order to facilitate educational success, but also beneficial circumstances consequent upon parental resources enhance children's educational opportunities. Educational inequalities between children of affluent and disadvantaged families arise from disparities in school performance and educational aspirations that shape educational decision-making. These disparities are both ascribed and achieved, as students from higher origin tend to perform better and have more ambitious goals than their peers with lower socioeconomic status backgrounds. The theories on the individual behavior that underlie educational inequalities posit that students and their families base their educational decisions on expected risks, costs, and benefits linked with making each educational transition (e.g., Breen and Goldthorpe, 1997; Erikson and Jonsson, 1996; Holm and Breen, 2016; Jæger and Breen, 2016).

Previous comparative research examining differences in educational attainment by socioeconomic background suggests that institutional context plays a significant role in explaining cross-national variance (e.g., Allmendinger, 1989; Breen et al., 2010; Breen and Jonsson, 2005; Erikson and Jonsson, 1996; Pfeffer, 2008; Shavit et al., 2007; Shavit and Blossfeld, 1993). Education is attained within a particular educational system, and the characteristics of each institutional context influence the extent to which family background can impact a child's educational career. Three particular features of national education systems seem to explain variation in equality of educational opportunity: first, the degree and timing of educational tracking; second, the cost of education; and third, enrolment rates. Less stratified educational systems have fewer tracks, tracking occurs at

older ages, and have zero or fewer dead-ends. These systems are often linked with lower level of educational inequalities (Breen and Jonsson, 2005; Brunello and Checchi, 2007; Triventi et al., 2016) because successful navigation through the system is less dependent on parental input. Second, decreasing financial constraints on educational attainment have been shown to narrow educational differences between children of different backgrounds (Beller and Hout, 2006; Birkelund, 2006; Black et al., 2014); low direct costs of tuition in addition to financial support from the state increase educational opportunities for those with fewer parental resources.

Third, higher enrolment rates increase educational opportunities because attaining educational certificates is less selective. The process of modernization is believed to account for the introduction of the educational policies and reforms that underlie educational expansion. Increased economic competition and a greater emphasis on skill-based recruitment practices has led to an increased emphasis on status attainment based on merit, whereby individual capabilities are expected to drive educational and socioeconomic attainment to a greater extent that ascribed characteristics such as family background (e.g., Hadjar and Becker, 2009; Treiman, 1970). Increasing participation rates in secondary- and tertiary-level education is thus assumed to provide more opportunities for families of all social strata to educate their children.

Some of the empirical evidence suggests that modernization has decreased intergenerational educational inequalities (e.g., Breen et al., 2010; Breen and Jonsson, 2005; Pöyliö et al., 2018; Torche, 2011; Treiman, 1970), especially by increasing the chances for upward educational mobility among children of less advantaged families (Ballarino et al., 2009; Breen, 2010; Pfeffer and Hertel, 2015). Others show that the effect of family background has remained relatively constant over time (e.g., Boliver, 2010; Lucas, 2001; Raftery and Hout, 1993; Shavit and Blossfeld, 1993). Latter results have been supported by the social reproduction theory (Bourdieu and Passeron, 1977; Van de Werfhorst and Hofstede, 2007), and that of maximally maintained inequality (Raftery and Hout, 1993), which state that educational expansion will not equalize educational attainment: even though access to higher levels of education becomes easier, it will first benefit those with an advantaged social background, maintaining the relative advantages of children from those families.

Sibling correlations in education

Most of the previous research on educational inequalities has examined the (vertical) association between observable dimensions of family background and child outcomes in two-generation models. Another analytical approach, analyzing similarity between siblings, has advantages over the vertical transmission approach: sibling similarity measured as a sibling correlation is an

omnibus measure capturing the overall effect of growing up in the same family (e.g., Björklund and Jäntti, 2012), and captures both observed and unobserved aspects of family background, be that due to shared social environment or shared genetic background. Thus, sibling correlations show the extent to which all shared family-level characteristics explain the variation in achieved level of education. Comparisons across countries and over time are more plausible when sibling correlations are used, because their interpretation is less biased by differences in the operationalization of measured variables. The "total" effect of the family background measured by sibling correlations also includes potential shared conditions such as peer groups and schools. Sibling correlations may be considered as a lower bound estimate of the effect of the family background (Björklund and Jäntti, 2012). In addition to the fact that siblings share 50% of genes on average, not all environmental experiences are shared, and parents may treat their children differently.

Previous research has shown that siblings tend to have more similar educational achievements than non-related individuals. Results from the United States and several European countries find sibling correlations in education that approximately range between 0.4 and 0.6 (Benin and Johnson, 1984; Björklund and Salvanes, 2011; Conley and Glauber, 2008; De Graaf and Huinink, 1992; Jencks et al. 1972; Hauser and Mossel, 1985; Hauser and Wong, 1989; Kuo and Hauser, 1995; Marks and Mooi-Reci, 2016; Sieben et al., 2001; Sieben and Graaf, 2003; Toka and Dronkers, 1996). Thus, approximately 40 to 60 per cent of the variation in educational outcomes is explained by differences between families. A study on educational transitions shows that sibling similarity was smaller at higher transition points (Sieben, 2001). Few previous studies have addressed cross-country differences in sibling similarities in education. Some previous studies have analyzed sibling similarities in education across several countries, finding few cross-country differences (Björklund and Salvanes, 2011; Grätz et al. 2019; Sieben et al., 2001; Sieben and Graaf, 2003). Results concerning temporal trends in sibling correlations in education are inconclusive. While some have reported a decline in the total effect of family background over time (De Graaf and Huinink, 1992; Marks and Mooi-Reci, 2016), others do not observe such a trend (Kuo and Hauser, 1995; Sieben et al., 2001; Sieben and Graaf, 2003; Toka and Dronkers, 1996).

The theories and evidence review above on intergenerational persistence in traditional two-generation studies offers a starting point for developing explanations for comparative and temporal differences in sibling similarity. It is likely that in countries with higher participation rates in education, less stratified educational systems, and a more generous welfare state, siblings are less prone to be alike, and that modernization and institutional changes, such as educational expansion, decrease sibling similarity over time. A study of temporal changes in sibling similarity in

occupational status suggests that modernization processes in the 20th century did decrease both the observed and unobserved influence of family background (Knigge et al., 2014).

Modernization theory concentrates on the ascribed effects of family background and considers it mutually exclusive to achievement. However, some researchers believe that increased meritocracy could strengthen a positive correlation between specific ascribed characteristics and achievement. According to this line of argument, an increase in merit-based status attainment would mean that the role of achievement-related effects of the family, such as skill development, would increase, because meritocracy allows children greater freedom to fulfill their genetic potential (Guo and Stearns, 2002; Nielsen, 2006). When merit is more strongly linked with educational outcomes, genes should, in principle, matter more for the total family background effect. This may even reverse the negative association between the importance of the family background and stronger meritocracy, provided that children in advantaged families have a greater genetic potential for educational achievement. There is some empirical evidence to back this assumption: the effect of genes for educational attainment seems to increase when the association between parents' and children's education is becoming weaker (Engzell and Tropf, 2019; also Heath et al. 1985; Marks, 2010). Thus, it is unclear whether educational expansion changes the total effect of the family background (i.e., sibling similarity) on educational attainment, because the total effect encompasses characteristics that can be both achieved and ascribed at the same time.

Most of the previous empirical research on cross-country and temporal changes has addressed the question of intergenerational persistence by estimating the association between family background and the final completed educational level as a single indicator for socioeconomic persistence across the whole educational distribution. The studies have either assessed intergenerational associations by examining how measured attributes of parental background are linked with the achieved educational level of their offspring or by assessing sibling correlations. Constructing a single indicator for socioeconomic persistence is practical, but limits the analysis of institutional differences. Single measurements of educational attainment, such as years of education, fail to acknowledge country-specific characteristics (Schneider, 2010). Cross-country and cross-temporal differences in institutions and the volume of education are often specific to certain levels of education. Though educational expansion often happens first through the expansion of lower levels of education, and later through expansion of higher levels of education, country-specific attributes determine the timing of, and the extent to which, each educational level expands and opens access for children of varying origins.

When applying a single indicator of educational achievement, up to half of sibling resemblance in education has been shown to be attributable to measured family characteristics (Hauser and Wong, 1989; Marks and Mooi-Reci, 2016; Sieben et al., 2001; Sieben and Graaf, 2003; Toka and Dronkers, 1996). Some have argued that in certain institutional contexts the unexplained part of the sibling resemblance is mainly driven by genetic endowment, and particularly cognitive ability (Marks and Mooi-Reci, 2016; Sieben and Graaf, 2003). Some previous studies also report a declining temporal trend in the observed part (often parental education or socioeconomic position) of the assessed sibling similarity (Sieben et al., 2001; Sieben and Graaf, 2003; Toka and Dronkers, 1996).

Institutional contexts in the present study

In this study we compare total family background effects in Finland, Sweden, Germany, and the United States. Finland and Sweden are both examples of Nordic welfare states where socioeconomic and educational inheritance is considered comparatively weak due to late tracking and free-of-charge educational systems; Germany, on the other hand, can be considered as an example of an early tracking system but with small or non-existing educational fees at higher levels of education; the US is an example of a society with relatively high level of education and a system without tracking but fairly strong education inheritance with high costs of participation in higher education (e.g., Björklund and Salvanes, 2011; Pfeffer, 2008; Triventi et al., 2016).

The Finnish educational system is characterized by a lower level of stratification than the systems in most other Western countries (e.g., Pfeffer, 2008). The nine-year comprehensive school, compulsory to all Finns, continues until the age of 16 and is uniform without any tracking through a standardized curriculum. The current comprehensive school system replaced the previous two-track system in the 1970s, the goal being to offer equal educational opportunity regardless of parental background. The old system assigned students to one of two tracks after four years of uniform education: the vocationally and academically oriented tracks had different content and provided different eligibility for further education. Upper-secondary education is divided into general (or academic) and vocational tracks lasting two to four years, and completed qualifications in either track give eligibility for higher education. While universities concentrate on academic education up to doctoral degrees, polytechnics (or universities of applied sciences) are professionally-oriented institutions that confer mostly bachelor-level programs that last for three to four years. The economic barriers for attaining educational qualifications are few as there are no tuition fees at any educational level. The Finnish higher education system expanded between the 1960s and 1970s, increasing the number of universities, and in the late 1980s polytechnics were introduced. The

proportion of working-age Finns with tertiary-level education rose from less than 10 per cent to over a third between the 1970s and the 2010s, and the proportion of those with no post-comprehensive schooling declined from 75% to less than a third (Statistics Finland, 2011; OECD 2013).

The Swedish education system also has a relatively low level of stratification, partly due to the fact that education in Sweden is state funded at all levels and tertiary education is free (Högskoleverket, 2012). The system is divided into three sections: *grundskolan*, which is 9 years of compulsory schooling; *gymnasium*, which is three additional years of upper secondary education; and tertiary education (Halldén, 2008).The tertiary education system in Sweden has degrees at the bachelors, masters, and doctoral levels. The vocational tertiary education system consists of practical, technical, and occupation-specific tertiary training programs. The 1970s through to the 1990s was a period of substantial change in the Swedish educational system (Halldén, 2008). In 1965 and 1971 gymnasium was reorganized into three tracks: the first prepared students for university, the second was a two-year continuation program, and the third was two years of vocational training (Erikson and Jonsson, 1996). While the first track was the most direct route to a typical university education, it was not impossible to apply to university from either of the latter two tracks (Halldén, 2008). Before 1971, these three educational tracks were split into separate schools, and applying to university directly from either of the less traditionally academic tracks was much more difficult. Like Finland, the post-war period in Sweden witnessed rapid educational expansion, with higher proportions attending upper-secondary education, an expansion of adult education, and the creation of a significant number of new universities and university colleges (Erikson and Jonsson, 1996). Today over one third of the Swedish population has undergone post-secondary education, which is higher than the OECD average (Högskoleverket, 2012).

Compared to most of the other Western educational systems, the German system has been depicted as one of the most rigidly stratified systems: tracking occurs at a relatively young age. Students are tracked according to their abilities after they have completed 4 or 6 years of primary education, depending on the state. Tracking of children is based on teachers' recommendations and parents' preferences but this also varies across states. Students are sorted into two or three hierarchically ordered secondary school types. The following three school types exist but not in all states: The basic secondary track (*Hauptschule*) lasts 4 to 5 years after primary school and generally prepares for vocational education in form of apprenticeships. Students following the middle track (*Realschule*) study approximately 6 years after primary school, and usually continue to higher vocational schools thereafter. The highest track (*Gymnasium*) preparing for post-secondary

education takes 9 years of schooling. In some states, schools exists that combine all three tracks within one school (*Gesamtschule*). The final examination of *Gymnasium* (*Abitur*) can be considered as a bottleneck for tertiary-level studies in Germany, because it (or a set of exams corresponding with it) is a prerequisite for tertiary-level education (Mayer et al., 2007). However, there are also alternative ways to obtain certificates that allow students to enter university. The tertiary-level system in Germany distinguishs two types of institutions: universities and universities of applied sciences (*Fachhochschule*). The latter offers the same degrees as universities except for doctoral-level degrees; however, they are more practically-oriented than universities that give scientific training and academic skills. Most of the German tertiary institutions are public institutions, where higher education is free of charge or can be obtained for a very low fee. In Germany the post-war period was also a time of education expansion. The number of students enrolled in tertiary education in West Germany increased more than tenfold between the 1990s and the 1950s. After this rapid period of educational expansion, the number of students plateaued in the 1990s and the 2000s (Mayer et al. 2007). Today Germany has a comparatively high level of secondary-level educational attainment: over 85 per cent of the working age population have completed at least a secondary-level qualification, and a little less than 30 per cent have gained tertiary-level education (OECD 2013).

In the U.S., compulsory school is universal and free of charge for all. After compulsory school, practically all children attend secondary-level high school as it is mandatory to a certain age. In high school, students choose academic or vocational courses; thus, the educational system in the U.S. does not divide students into academic and vocational tracks during secondary-level education (Andrade and Thomsen, 2018). After high school, students can enroll in postsecondary education to complete either an academic or a vocational degree. Community colleges and other vocational institutions provide vocational education and college transfer programs, the latter giving the possibility to enter bachelor-degree studies. Colleges and universities offer academic lower tertiary-level undergraduate studies (often bachelor's degrees), many of which provide eligibility to continue to higher tertiary-level education. Thus, the U.S. educational system is usually described as having a low level of stratification (e.g., Pfeffer, 2008). The key difference between the U.S. educational system and most European countries is the large number of private schools and universities, and lower level of nation-wide standards with regard to the quality of education. Furthermore, all postsecondary institutions collect tuition fees in the U.S.; fees are much higher at private than public colleges and have been increasing from the 1980s, particularly at private institutions (Roksa et al., 2007). Because of tuition fees, the U.S. educational system is

characterized by high financial constraints for individuals and families and high horizontal stratification between institutions, with private institutions often valued higher than public institutions. As in Europe, expansion in post-secondary education began in the post-war period, the rapid expansion starting at a 20 per cent enrollment rate among 18-22-year-olds in 1945 and reaching 77 per cent by 1992. At the beginning of the 2000s, over one-quarter of the population had a college degree (Roksa et al., 2007). In the U.S., the federal government has been reluctant to shape educational institutions directly but has focused on helping students meet rising education costs. For example, the largest educational reform, the 1965 Higher Education Act, introduced funding for several programs assisting low-income students (Roksa et al., 2007).

AIMS

To overcome the limitations of previous studies and shed further light on the underlying mechanisms by which family background translates into inequalities in attained education, we provide a comparative and a temporal perspective on sibling similarities. We aim to answer the following research questions in this paper: first, we assess the extent to which sibling similarities vary across levels of education between four countries: Finland, Sweden, Germany, and the United States; second, we examine whether any changes over time can be found by analyzing sibling similarities between 1990 and 2015 at each level of education; third, we estimate the extent to which observed parental education accounts for the estimated sibling similarities. We aim for macro-level explanations for differences between countries and between levels of education. As the focus is on differences between educational levels, we are able to capture the distinct nature of each level as an educational pathway in each institutional setting. Finding no cross-country differences would indicate that sibling similarity stems solely from family-level mechanisms not influenced by contextual differences. Previous research has found institutional and cross-country variation in educational inequalities, although studies do not agree on the rankings of countries in this respect (e.g., Bar Haim and Shavit, 2013; Breen et al., 2010, 2009; Grätz et al. 2019; Pfeffer, 2008; Pöyliö et al., 2018; Van de Werfhorst and Mijs, 2010).

To our knowledge, no previous study has examined how the total effect of family background differs across achieved levels of education. In studies focusing on educational transitions, differences by family background are considered to be smaller in later stages of the educational career due to social selection. Given the selection occurring at earlier steps in the educational pathway, those attaining the highest level of education are very selected group. Also, due to educational expansion, attaining only the lowest level of education has become less and less

common, as secondary level has enlarged extensively throughout industrialized countries. Additionally, a recent study on educational performance points toward elevated differences according to family background at the bottom of performance distribution (Grätz and Wiborg, 2020). If the weakest performing students are most likely to acquire no more than compulsory education, this should increase the importance of family background for educational attainment at that level. Thus, we expect the total contribution of family background to be stronger at both ends of the educational distribution, resembling a u-shaped pattern in which those attaining the lowest and the highest level have highest sibling similarity. Also, we expect this pattern to be steeper in Germany and in the U.S. relative to Finland and Sweden, as the level of educational inequalities are lower in the latter countries due to less stratified educational systems.

Owing to institutional differences, temporal changes in the total effect of family background are likely to vary by country. In keeping with the notion of educational expansion, we expect to find slight changes in sibling similarities in Germany where some expansion has occurred during the studied period. The expansion occurred particularly in secondary-level education, owing mainly to removals of educational dead-ends. Fewer nationwide reforms have been implemented and hardly any expansion has occurred in the U.S., as enrollment rates in the highest educational level increased during earlier decades. We therefore assume no clear cross-temporal change to be found in the U.S. Due to extensive educational expansion in the Nordics, we expect cross-temporal changes to be clear in Finland and in Sweden. Higher education in Sweden expanded earlier than in Finland, and the expansion was stronger at the higher tertiary level. Therefore, we expect the decline in sibling similarities at the higher tertiary level to be more distinct in Sweden.

However, the contribution of educational expansion to sibling correlations in education is unequivocal. If meritocracy is understood as a system that allows individuals to reach their genetic potential better, if modernization increased merit-based status attainment, and if children from higher socioeconomic status families have a genetic makeup that is more potent for educational success, the role of family background may increase over time (Guo and Stearns, 2002; Marks, 2010; Nielsen, 2006; Sieben et al., 2001). Following Young's (1958) dystopian view on meritocracy, a possible alternative hypothesis is that the rising contribution of inherited abilities would cause sibling similarities to increase over time at all levels of education. Due to less stratified educational systems, we could expect this course of development to be most applicable to the Nordics, especially to Finland where the highest level expanded less than in Sweden.

The extent to which observed parental education explains the overall sibling resemblance indicates how parents can utilize their education-related resources to facilitate their children's educational

attainment. Specifically, parental education may reflect cultural resources that benefit their children in educational decision-making processes. The share of the sibling correlation explained by parental education can be expected to be higher in countries where the proportion educated to the highest level is lower, as navigating through these systems demands more parental resources. Correspondingly, we expect the contribution of observed parental education to be highest in Germany. Additionally, parental education reflects financial resources. Compared to the U.S, we assume that the contribution of observed parental educational level will be lower in the Nordics, as they collect no tuition fees at any level of education. Thus, direct monetary investments are less potent as a means to influence children's outcomes in adulthood. Correspondingly, we expect the contribution of observed parental education to be higher in the U.S compared to the Nordics, as a wider array of strategies to promote children's educational attainment is available in the U.S.

We also expect the proportion of the variance explained by observed parental education to be higher the higher the level of attained education. It is likely that parental resources other than those related to education are more important at lower levels of children's education. If modernization theory holds, a higher level of educational expansion leads to smaller differences in the contribution of observed parental education between levels of education: thus, parental education would temporally play a less significant role in the highest level of attained education in the Nordics. A counter hypothesis for this would follow the maximally maintained inequality (MMI) hypothesis, which suggested that educational inequalities persist unless the supply of education at a specific level surpasses its demand by the more advantaged socioeconomic groups, who are the first ones to grasp the educational opportunities (Raftery and Hout, 1993). Accordingly, the contribution of observed parental education would enlarge simultaneously with educational expansion, as the highest levels of education would specifically open up for children of high strata.

DATA & METHODS

Data sets and variables

We used full-population register data for Finland and for Sweden, and survey data for Germany and the U.S. In all countries, only individuals with information on observed parental education were included. The Finnish data were obtained from Statistics Finland. The annually-updated data set comprises all individuals residing in Finland in any given year between 1987 and 2015. Altogether 2,352,699 Finnish individuals were included in the analysis. Individuals having the same (biological or adoptive) mother were identified as siblings. The Swedish register data was accessed through

Statistics Sweden. We conducted our analysis on cohorts born 1955-1981, on a total of 2,561,437 individuals. Siblings were defined as those sharing a biological mother and a biological father. For Germany, we used the German Socio-Economic Panel Study (SOEP). The SOEP is an annual representative household panel of the population in Germany running since 1984 (Goebel et al. 2019). For the present paper, we use version 33.1, which gives us an analytical sample of 1,991 individuals for the analysis. Results for the U.S. were based on the nationally representative sample from the Panel Study of Income Dynamics and the Socio-economic Panel (PSID). The PSID started in 1968 with an initial panel of approximately 4,800 families that were interviewed annually until 1995 and biannually up to the latest round in 2015. Data for the U.S. included 10,785 individuals.

Child's attained education was measured between ages 31 and 39 in each country in approximately five-year intervals between 1990 and 2015 according to data availability. A categorical measurement of education was used to enable comparison between levels of education. To begin with, we analysed achieved educational level categorized into three groups in each country: the lowest level labelled as "basic level" referred to compulsory schooling: in Finland and Sweden this category included those who have completed compulsory education only (9 years) and in Germany those who have not completed any education beyond general elementary education (4 years). In the U.S., the lowest level was labelled "less than high school" and referred to those who had not completed a high school degree. The middle category was labelled "secondary level" and referred to those with academic or vocational (upper) secondary degrees after compulsory schooling as their highest completed degree in Finland, Sweden, and Germany. The middle category in the U.S. was labelled "high school" and concerned high school graduates without further education. The highest category "tertiary" referred to completed post-secondary degrees obtained from higher education institutions such as universities, university colleges, colleges, or universities of applied sciences.

Parental education was measured similarly to offspring's achieved education in Finland, Sweden, and the U.S. Due to data availability, the German variable for parental education distinguished parents with and without secondary-level degree. In two-parent families, parental education was indexed by the highest education between the two parents.

To provide more detailed information on levels and temporal trends, we next continued our analysis concentrating on Finland and Sweden. Data on these countries allows us to sub-divide the aforementioned educational variables to better understand differences between educational levels and over time. For this purpose, we separated tertiary-level achieved educational level into three categories: lower tertiary, higher tertiary, and doctorate level. In Finland, lower tertiary-level

education refers to degrees from universities of applied sciences, whereas it refers to shorter degrees from universities and university colleges in Sweden. Higher tertiary-level education refers to university-level master's degrees and doctoral level to doctorates in both countries.

Methods

Our observations were clustered according to families and our outcome is the dummy variable of each level of education. Thus, we used linear probability random intercept multilevel models. Mathematically, we estimated

$$y_{ij} = \beta'X_i + \delta_i + \varepsilon_{ij}, \tag{1}$$

where y_{ij} denotes the dummy variable for each level of the child's attained education, X_i refers to the observed level of parental education, δ_i is the residual reflecting differences in the outcome due to unobserved family-level heterogeneity (which does not vary between the children of the same family), and ε_{ij} is the error term of each child reflecting unobserved individual-level heterogeneity that does not originate from the shared background.

The estimated model allows for comparing the family-level variance to the total variance in the model, the latter referring to the sum of the family- and individual-level variance $\sigma^2_{\delta_i} + \sigma^2_{\varepsilon_{ij}}$. As follows, the sibling correlation ρ can thus be calculated with

$$\rho = \frac{\sigma^2_{\delta_i}}{\sigma^2_{\delta_i} + \sigma^2_{\varepsilon_{ij}}}. \tag{2}$$

The sibling correlation ρ thus estimates how much shared family background explains attained education, and can be interpreted as the correlation between two randomly drawn pairs of siblings: the stronger the ρ, the more the siblings would be alike, and thus the stronger the total effect of family background.

Modeling strategy

As we were interested in the total effect of family background on each level of education, we began our analyses by running an "empty" model without observed parental education (in other words equation (1) without X_i) for each level of achieved education and each of the studied periods. Thus, each of our models contains the whole analytical sample rather than a sub-sample at risk of making a particular educational transition. The models estimated the baseline level of the total family background effect. We then included observed parental education (X_i) in the model. This decomposition specifies the explanatory power of the observed parental education. Controlling for

parental education that is shared among siblings reduces unobserved family-level variance. Comparing the empty models to the ones adjusted for parental education allows us to assess the extent to which the total family background effect is explained by parental education.

Table 1. Descriptive statistics of 31- to 39-year-olds in each calendar year

		Achieved education		Parental education		Intergenerational persistence		
		% lowest education[1]	% highest education[2]	% lowest education[3]	% highest education[4]	% of lowest educated with lowest parental education	% of highest educated with highest parental education	N
Finland	1990	25.74	29.85	71.78	11.73	82.68	23.97	634,476
	1995	19.04	33.75	61.09	16.11	73.74	28.67	653,972
	2000	15.33	38.63	48.00	21.56	61.40	34.25	630,236
	2005	13.68	43.08	33.39	28.94	48.00	42.29	559,456
	2010	10.80	45.73	20.27	37.38	34.43	51.09	545,195
	2015	9.95	44.55	12.87	43.35	24.35	58.23	572,405
Sweden	1990	20.29	28.45	71.06	17.36	86.26	33.91	446,233
	1995	15.11	28.99	64.05	22.97	81.59	42.40	482,691
	2000	9.29	33.34	57.51	27.73	77.34	47.25	525,363
	2005	7.71	42.17	48.73	34.79	71.86	52.83	500,803
	2010	7.59	48.52	42.81	40.63	64.75	57.01	436,758
	2012	8.35	50.01	41.02	42.77	63.40	59.05	425,397
Germany	1995	15.81	17.93	92.40	7.60	100.00	33.90	329
	2000	15.79	18.49	89.76	10.24	100.00	34.62	703
	2005	12.15	20.34	87.05	12.95	100.00	33.77	757
	2010	6.28	26.41	80.03	19.97	100.00	44.51	621
	2015	5.41	35.87	67.54	32.46	96.40	59.22	499
The U.S.	1990	15.55	17.16	29.08	9.54	46.11	33.94	2,232
	1995	13.49	14.81	27.11	10.27	47.95	38.22	2,350
	2001	9.79	16.80	18.87	13.30	40.88	38.72	1,399
	2005	9.71	18.71	13.04	14.10	32.12	35.98	1,411
	2009	7.63	27.70	9.98	14.30	29.92	33.62	1,664
	2015	6.98	19.16	7.22	15.05	17.57	38.18	2,119

[1]Proportion of individuals without any post-compulsory education in Finland, Sweden, and Germany; proportion of individuals without a high school degree in the U.S.
[2]Proportion of individuals with a completed post-secondary education in Finland, Sweden, Germany, and in the U.S.
[4]Proportion of parents without any post-compulsory education in Finland, Sweden, and Germany; proportion of parents without a high school degree in the U.S.
[4]Proportion of parents with a completed post-secondary education in Finland, Sweden, and in the U.S; proportion of parents with a secondary-level degree in Germany.

RESULTS

Table 1 shows descriptive information for each country. The proportion of those educated to the lowest level declined and the proportion of those educated to the highest level increased over time

in each country, the trend being more pronounced in parental than achieved education. This is also shown in crude measures of intergenerational persistence, as over time fewer individuals with lowest level of education have parents educated to the same level.

To detect the total contribution of family background on educational attainment in different contexts and over time, we compare sibling correlations across levels of the highest completed education between Finland, Sweden, Germany and the United States. Before this, to enable a comparison with the traditional approach of measuring the highest completed level of education, results in which achieved education is measured as a linear measurement of years of education are provided in Figure 1. This approach shows that sibling similarity was higher in Germany (between 0.45 and 0.6) compared to other studied countries (approximately 0.4), and it remained at a rather stable level between 1990 and 2015 in all countries. Observed parental education explained approximately one fifth of the sibling similarity in Finland and in Germany, and one fourth in Sweden and in the U.S., the proportion explained increasing slightly in all countries over time.

Figure 1. Sibling correlations on years of attained education with 95 % confidence intervals in Finland, Sweden, Germany, and the United States among 31- to 39-year-olds by calendar year. Decomposed to show the proportion explained by observed parental education.
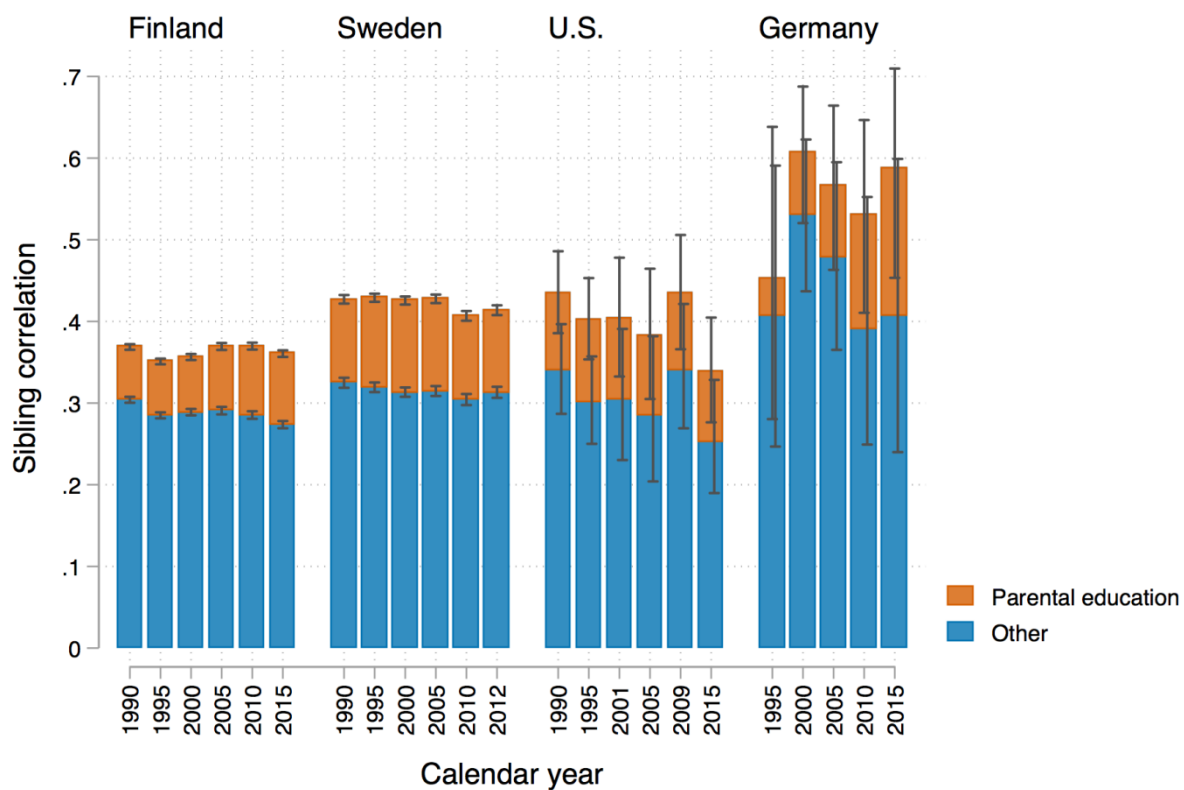
Note: Intraclass correlations from linear random intercept multilevel models, calculated separately for each country and calendar year.

Next, we turn into investigating differences across levels of education. Due to data availability, we examine three levels of education in each country. Compared to sibling correlations estimated in a linear model with years of education as the outcome (Figure 1), the overall level of sibling similarity is slightly lower when analyzing educational levels with linear probability models (Figure 2). This is a feature of linear probability models examining binary outcome variables: due to less variance in the outcome compared to a continuous outcome, and value 1 being rarer than value 0, the intraclass correlation is smaller. Thus, the level of sibling similarity attained when using linear probability models should not be compared to previous studies using non-binary outcomes, but it does enable comparison between levels of education, between countries, and over time in this study.

As in the linear model that used years of education as the outcome, the highest level of sibling similarity was found in Germany when analyzing sibling correlations across levels of the highest completed education (Figure 2). Sibling correlations were most pronounced in the highest level of education (tertiary) in all studied countries. This correlation ranged from approximately 0.3 in Finland to approximately 0.5 in Germany. In Finland and the U.S, the second highest sibling similarity was found in the lowest level of education, while in Sweden and Germany sibling similarity was in a somewhat same level among both those educated to the lowest and those educated to the secondary level. In Finland and Sweden, sibling correlations among the lowest educated were approximately 0.2 and in Germany and the U.S. approximately 0.3. Sibling correlations among those educated to the secondary level ranged from approximately 0.1 in Finland to approximately 0.3 in Germany.

With regard to temporal trends, sibling correlations increased slightly during the studied period at the secondary level in Finland and in Sweden, and decreased at the basic level in Sweden. Because of wide confidence intervals, it is difficult to make interpretations regarding changes over time in Germany and in the U.S. Tentatively, in Germany sibling similarity seems to decline between 1995 and 2010 and the peak again in 2015 in secondary and tertiary level. In the U.S., a slight tendency toward declining correlations is detectable in secondary and tertiary level.

Next, we analyzed the magnitude of the observed level of parental education contributing to the sibling correlations. Estimates in Figure 2 are decomposed to show the proportion explained by observed parental education. In all studied countries, the contribution of observed parental education was highest at the tertiary level. The contribution was somewhat higher in the U.S. and in Germany compared to the Nordic countries, at least at the highest level of education. When it comes to temporal changes, the contribution does not seem to change over time at the lowest educational level in any studied country. At the secondary level, the contribution of parental

education increased to some extent in all countries except the U.S. At the tertiary level, the contribution remained at a rather constant level in all countries except Germany where it increased.

Figure 2. Sibling correlations on highest attained level of education with 95 % confidence intervals in Finland, Sweden, Germany, and the United States among 31- to 39-year-olds by educational level and calendar year. Decomposed to show the proportion explained by observed parental education.
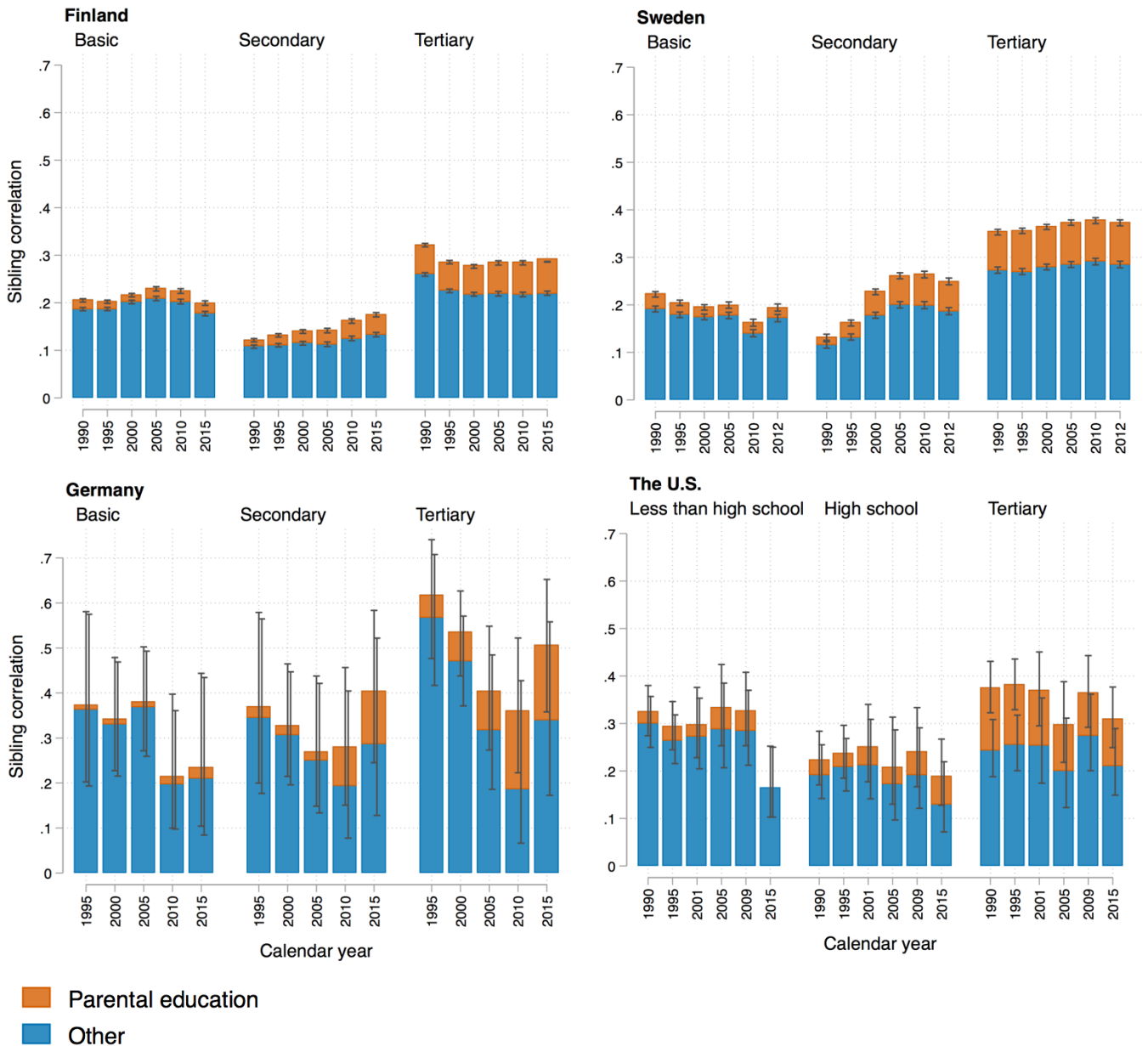
Note: Intraclass correlations from linear probability random intercept multilevel models, calculated separately for each country, level of education, and calendar year.

To take a closer look at different educational levels and temporal trends, we employ Finnish and Swedish register data sets to analyze tertiary level in more detail. As educational expansion has mostly occurred in higher education, it is reasonable to consider different levels within the tertiary

18

level. Results are presented in Figure 3 which shows that sibling similarity was clearly highest in higher tertiary level compared to lower tertiary and doctorate levels. As completing a doctoral degree is very rare, sibling similarity remained at a lower level than at any other educational level. In Finland, sibling similarity at the higher tertiary level declined over time, whereas in Sweden it first declined until 2000 and thereafter increased again. There was also a decline at the lower tertiary and doctorate levels in both countries, the decline being more pronounced at the lower tertiary level. It should be noted, however, that the decline at the lower tertiary level in Sweden is probably driven by changes in the educational system as many of the short tertiary-level degrees were abolished at the beginning of the 2000s. The contribution of observed parental education was also clearly highest at higher tertiary level, with hardly any period variation.

Figure 3. Sibling correlations on highest attained level of education with 95 % confidence intervals in Finland, Sweden among 31- to 39-year-olds by educational level and calendar year. Decomposed to show the proportion explained by observed parental education.
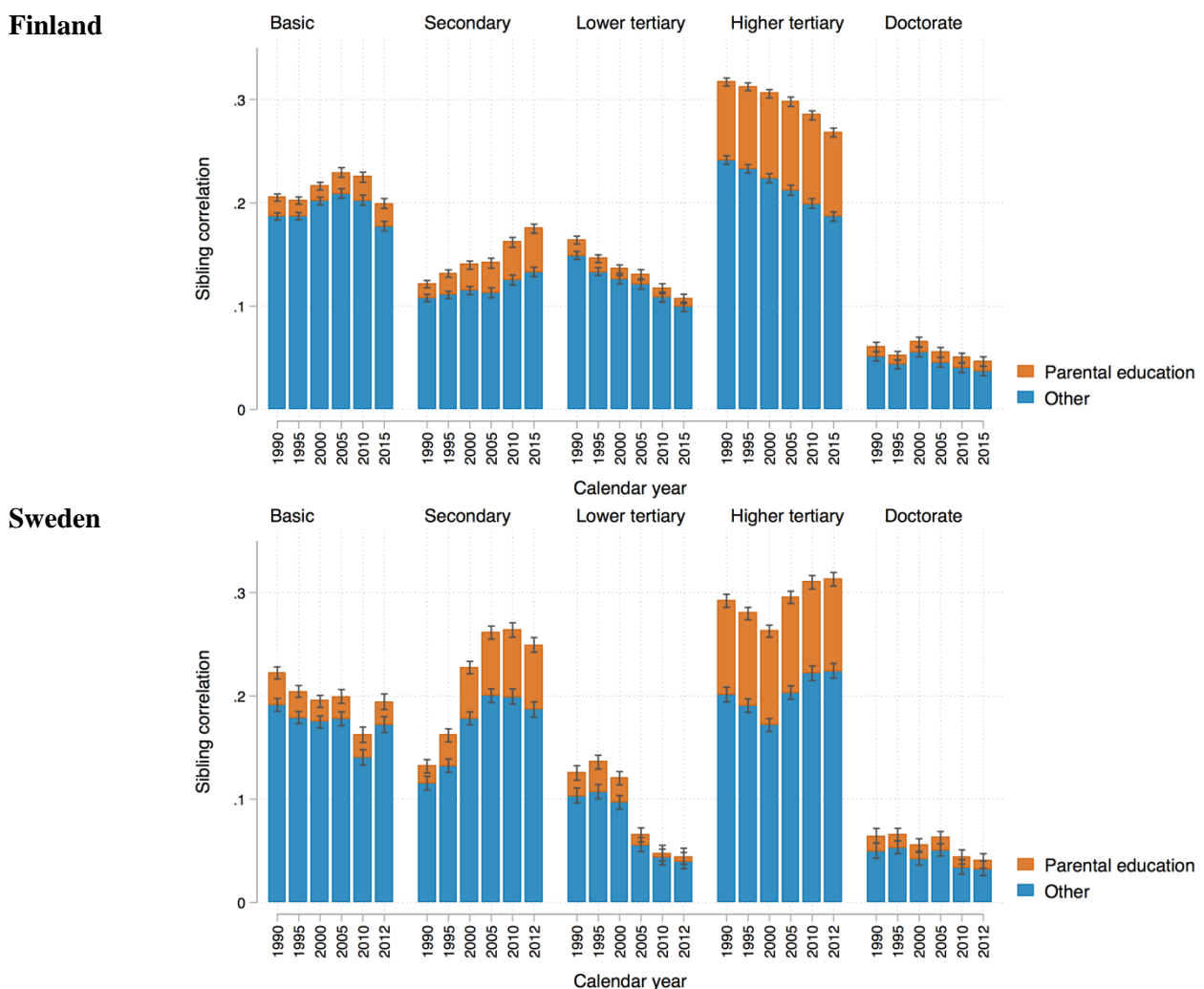
Note: Intraclass correlations from linear probability random intercept multilevel models, calculated separately for each country, level of education, and calendar year.

DISCUSSION

This article analyzed educational inequalities by examining the effect of family background at different levels of education and its temporal variation in Finland, Sweden, Germany, and the U.S. We found a pattern indicating that the family background matters most among those educated to the lowest and the highest levels. Sibling correlations were highest for tertiary level education. The pattern was most distinct in Finland and in the U.S., whereas the difference between those educated to the lowest level and the middle (secondary) level was less clear in Sweden and Germany. We further found only minor changes over time that varied across countries and levels of education. Observed parental education explained a rather small proportion of the total family background effect, the contribution being highest at the highest level of education, and in the U.S. and in Sweden. Overall, we show that differences between levels of education are more distinct that differences between countries, both in terms of the overall level of sibling similarity and the proportion explained by observed parental education.

In line with our expectation based on social selection, we found stronger sibling similarity, and thus higher total family background effect, at the ends of the educational distribution, resembling a u-shaped pattern. The family background effect was particularly high in the highest level, indicating that selection by social origin at lower levels of the educational system translates into stronger inequalities at the highest level as suggested in previous studies (e.g., Breen and Jonsson, 2000; Lucas, 2001; Mare, 2011; Shavit and Blossfeld, 1993). A more detailed look at those educated to the highest level in Finland and Sweden revealed that the high similarity between siblings predominantly stems from the higher tertiary level, while family background accounted for notably less of the variance at the lower tertiary level and doctorate level. Consequently, when results on levels of education are compared to the conventional approach using years of education as the outcome, our findings suggest that the previous results are mainly driven by the total family impact among those educated to the tertiary level.

The total family background effect at the lowest level of education was not as elevated as we expected based on social selection and previous findings on the importance of family background at the lower end of educational performance distribution (Grätz and Wiborg, 2020). The sibling correlations at the lowest level were higher compared to the secondary level in Finland and the U.S., while in Sweden and Germany they were more or less at the same level. Accordingly, the pattern varied across countries otherwise than we had expected: we assumed the Nordic countries would have a less distinct u-shaped pattern. Instead, our findings indicate that the lowest level of education is more differentiated in Finland and in the U.S. However, our finding that Germany has

the highest level of sibling similarity across all educational levels (cf. Björklund and Salvanes, 2011) suggests that the highly stratified educational system does play a significant role in shaping educational attainment (Breen and Jonsson, 2005; Brunello and Checchi, 2007; Triventi et al., 2016).

Period changes in sibling similarity were rather small. We found mixed support for our expectation that sibling similarity in educational attainment would increase among the lowest educated and decline at the highest level due to educational expansion. Temporal changes in the lowest level were undetectable. Thus, even though fewer children remained at the lowest level over time, this development does not seem to result from stronger selection in terms of family background. On the contrary, the effect of family background seemed to increase at the secondary level in the Nordics. This is rather surprising considering that the proportion of those educated to the secondary level has not changed over time as much as it has at other levels. The increase was associated with a growing importance of parental education for intergenerational attainment, which may suggest that the unobserved aspects of family background that were also becoming more important for parents' educational attainment are behind the increase.

Declining sibling correlations at the tertiary level would support the notion that educational expansion has opened up educational opportunities for those with less privileged backgrounds and thus decreased social selection (e.g., Breen et al., 2010; Breen and Jonsson, 2005; Torche, 2011; Treiman, 1970). However, contrary to our hypothesis, this trend over time was not found in Sweden. In theory, this could also be explained by increased importance of genetic inheritance due to the assumedly growing meritocracy (Guo and Stearns, 2002; Nielsen, 2006), similarly to the findings at the secondary level of education. However, the importance of parental education remains largely fixed over time, suggesting that the explanatory mechanism should be different at the secondary and higher tertiary level of education in Sweden. We do find lowest amount of cross-temporal changes in the U.S., indicating that fewer nationwide reforms and less educational expansion during the studied period may translate into less cross-time variation. To sum, it seems that the link between cross-country variation in educational expansion and sibling similarity in educational attainment is not obvious, as both achieved and ascribed characteristics are included in the total effect of family background measured as sibling resemblance.

The proportion of the total family background effect explained by observed parental education was small, and smaller than expected according to previous studies (Hauser and Wong, 1989; Marks and Mooi-Reci, 2016; Sieben et al., 2001; Sieben and Graaf, 2003; Toka and Dronkers, 1996). Endowments other than resources linked to parental education thus seem to be more important with

regard to educational achievement. We do find that parental education explains a larger share at the highest level of education, supporting our hypothesis on larger contribution of education-related parental resources when navigating through the educational system to the highest level. Tentatively, as we expected, the proportion explained by observed parental education was slightly lower in the Nordics than in Germany and the U.S., reflecting institutional differences in parents' capability to promote children's educational career. Contrary to previous findings (Sieben et al., 2001; Sieben and Graaf, 2003; Toka and Dronkers, 1996), we did not detect a declining contribution of observed parental education over time. Quite the opposite, the proportion remained at a rather constant level or increased slightly, the increase being most notable at the secondary level. Thus, it remains uncertain whether modernization has diminished differences between levels of education in the proportion explained by observed parental education. It might be more likely that, in accordance with the notion of maximally maintained inequality (Raftery and Hout, 1993), attaining secondary level education has become more unequal. But equally well it may be that while the importance of the socioeconomic characteristics of the family are diminishing, the role of genes we are not observing is increasing due to meritocracy (Guo and Stearns, 2002; Marks and Mooi-Reci, 2016; Nielsen, 2006). In sum, both the observed and unobserved parts of the sibling correlations seem to contribute to the small temporal changes in sibling similarity.

The approach that we have applied to analyze educational inequality has its limitations. Though sibling correlations have their advantages in measuring the effect of family background, they can be criticized as somewhat indefinite; measuring the extent to which siblings are alike contains achieved and ascribed aspects that are not all directly attributable to parents such as schools, neighborhoods, and the way siblings influence each other. Then again, sibling correlations may not capture all aspects of parental input, such as time-varying parental resources or differential treatment between siblings. Moreover, the results from linear probability models are not entirely comparable to the conventional approaches using linear models, and may by biased when used with a rare outcome due to the model's functional form. Results are nevertheless comparable across levels of education, countries, and calendar years.

Despite these limitations, this study provides valuable new insights into the role that contextual factors play in shaping educational inequality, mechanisms of social reproduction, and the magnitude of parental influence. Our results corroborate the finding that highly stratified educational systems produce greater disparities in educational outcomes between children of disadvantaged and advantaged families, but educational expansion seems to play a less important role. Moreover, both the level of sibling similarity and its temporal variation are not universal

across educational levels or across countries, indicating that institutional features moderate levels of parental influence across different levels of education.

As social selection differs across levels of education, this suggests that the mechanisms of intergenerational inequalities are likely to also differ across levels. Along with cultural, social, and economic resources, it is likely that cognitive abilities and other traits transmitted from parents to children operate differently at certain transition points in the educational pathway. This suggests that future studies should aim at disentangling the role of different family-background factors in explaining disparities between those who attain lower and higher education. This is also supported by our finding about the relative importance of observed parental education varying across levels of education. Thus, concentrating only on single measurements of educational outcomes, such as years of education or university enrollment, neglects to recognize the role of different dimensions of intergenerational persistence. Our results further suggest that many previous studies and applied approaches to analyze educational inequalities ignore a substantial part of the family background effect. Educational inequality seems to stem mainly from factors other than parental education, implying that there is still a lot to do in order to fully understand the processes of intergenerational transmission and educational attainment.

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