

Reinforcing at the Top or Compensating at the Bottom? Family Background and Academic Performance in Germany, Norway, and the United States

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Abstract

Research on educational mobility usually studies socioeconomic differences at the mean of children's academic performance but fails to consider the variation in the shape of socioeconomic differences across the outcome distribution. Theories of social mobility as well as theories about the resource allocation within families predict such variation. We use quantile regression models to estimate variation in socioeconomic differences across the distribution of academic performance using different indicators of family background (parental education, occupation, earnings, and wealth). We apply this approach to data on Germany, Norway, and the United States, three countries that represent different welfare and education regimes that may affect the intergenerational transmission of educational advantage. We find stronger socioeconomic differences at the bottom than at the middle and the smallest differences at the top of the performance distribution. These findings are virtually identical across all four indicators of family background. We also find no cross-national differences in the shape of socioeconomic differences in academic performance.

Introduction

In all advanced, industrialized societies, there are strong associations between family socioeconomic background and children's life chances measured via educational choices and academic performance (Breen and Jonsson, 2005; Björklund and Salvanes, 2011). Usually, research in this area focuses on whether children's academic performance varies *on average* by their family's

socioeconomic background. However, little research has examined whether socioeconomic differences in academic performance vary between children whose performance is low, average, or high. We focus on this theoretically important question that is also relevant to policies aimed at influencing educational inequalities.

Many theories predict socioeconomic differences in the shape of children's academic performance. Within a

family, children whose academic performance is high may benefit more from the same amount of parental investment than their low-performing counterparts (Becker and Tomes, 1986). Parents may also invest in their children in response to their academic performance (or, what is correlated with later academic performance, birth endowments). If parents focus their investments on the child whose academic performance (or birth endowments) is highest (Becker and Tomes, 1976), or if children with higher academic performance (or birth endowments) benefit more from the same amount of parental resources than their low-performing counterparts, a stronger association should emerge between family background and academic achievement at the top than at the bottom of the performance distribution. Conversely, if parents focus resources on the child with the lowest academic performance (or birth endowments) (Griliches, 1979; Behrman, Pollak and Taubman, 1982; Conley, 2008a), a stronger association should emerge between family background and academic performance at the bottom than at the top of the performance distribution. Compensatory behaviour by parents can occur if they want that their children avoid social downward mobility (Boudon, 1973; Breen and Goldthorpe, 1997; Jackson, 2013; Bernardi and Cebolla-Boado, 2014).

Families' strategies to reinforce or to compensate for children's academic performance are constrained by the parental resources available (Conley, 2008a; Hsin, 2012; Grätz and Torche, 2016; Restrepo, 2016). These constraints link different forms of parental behaviour within families to broader processes that generate inequalities between families (Boudon, 1973; Breen and Goldthorpe, 1997; DiPrete and Eirich, 2006).

Shedding light on the variation in socioeconomic differences in the shape of the performance distribution has important implications for our understanding of the intergenerational transmission of educational advantage.¹ By ignoring such heterogeneous effects, previous studies could have under- or over-estimated intergenerational educational mobility. In addition, knowledge about whether socioeconomic differences in academic performance vary for children whose performance is low, average, or high can inform policies that aim to increase equality of educational opportunity.

We test the two opposing predictions stated above about variation in socioeconomic differences in the shape of the performance distribution using quantile regression models. Family socioeconomic background is operationalized in a number of ways to ensure the generalizability of our findings, including measures of parental education, occupation, earnings, and wealth.

We apply this approach to data from three countries. We use the Socio-Economic Panel Study (SOEP) from Germany, the Panel Study of Income Dynamics (PSID) from the United States, and administrative register data from Norway. Comparing these countries is of theoretical importance, as they represent the three main types of welfare regimes found in advanced, industrialized societies (Esping-Andersen, 1990) and have different education regimes (Allmendinger, 1989; Busemeyer and Nikolai, 2010). Institutional theories argue that educational institutions' characteristics affect the intergenerational transmission of educational advantage (van de Werfhorst and Mijis, 2010). For instance, the German education system tracks students earlier into different types of schools than Norway and the United States. Early tracking may diminish educational mobility, but it may also lead to a more equal distribution of differences in social origin across different levels of academic performance. Previous research found particularly low levels of educational mobility in Germany and the United States compared to other Western societies (Shavit and Blossfeld, 1993; Pfeffer, 2008, 2015; Bradbury *et al.*, 2015). Our analysis not only offers a new test of this hypothesis, but it also tests whether the association between family socioeconomic background and children's educational performance varies across children with low, middle, and high academic performance in different ways in countries with different education and welfare regimes.

Background and Theoretical Considerations

The Importance of Family Background for Low, Middle, and High Academic Performance

Going back to ideas expressed by Boudon (1973), sociologists sometimes distinguish between so-called 'primary effects' and 'secondary effects' of social origin on children's educational outcomes (Jackson, 2013). The idea behind this distinction is that socioeconomic differences in educational attainment are due, on the one hand, to socioeconomic differences in academic performance ('primary effects') and, on the other hand, to socioeconomic differences in educational choices ('secondary effects'). Using this terminology, our study focuses on socioeconomic differences in children's educational performance, i.e. 'primary effects'.²

Theories explaining why family socioeconomic background affects children's educational performance lead us to expect that the importance of family background is different for children whose performance is low,

average, or high. The first theoretical approach we consider argues that the intergenerational transmission of education is strongly motivated by parents' attempts to avoid children's social downward mobility (Boudon, 1973; Breen and Goldthorpe, 1997; Jackson, 2013; Bernardi and Cebolla-Boado, 2014). This literature usually refers to educational decision-making, but in line with Bernardi (2014) and Bernardi and Grätz (2015), we argue that if parents aim to avoid social downward mobility, they may also do so by influencing their children's academic performance. If families are mainly motivated by avoiding social downward mobility, we would expect a stronger association between family background and academic performance at the bottom and at the middle than at the top of the performance distribution (Hypothesis H₁). We assume this to be the case because children who perform well in school are less at risk of experiencing social downward mobility. Children whose performance is low or average are particularly at risk of failing to achieve the same level of education, occupation, or earnings as their parents. Accordingly, socioeconomically advantaged parents may focus on improving the educational performance of these children.

Contrary to that, the cumulative advantage model (DiPrete and Eirich, 2006) leads us to expect stronger socioeconomic differences at the top than at the middle or at the bottom of the performance distribution (Hypothesis H₂). This may be the case if parents invest equally in their children. This assumption is usually made in research on intergenerational mobility (Conley, 2008a). Within families, high-performing children may benefit most from the same amount of parental support (Becker and Tomes, 1986). Greater benefits from parental investments for children whose academic performance is high lead to an increase in the association between family background and children's academic achievement across the performance distribution. Differences between families in parental resources strengthen this pattern. High-ability children in families with many resources benefit more from parental investments than their counterparts with fewer resources.

In addition, parents may also reinforce differences between siblings if they want to ensure the success of the child whose academic potential is the greatest (Becker and Tomes, 1976). This strategy will be more effective for parents from socioeconomically advantaged families who have more resources available to influence child development (Conley, 2008a). If parents reinforce differences between siblings, we expect a process of cumulative advantage to occur (DiPrete and Eirich, 2006). This theory thus predicts a stronger association

between family background and academic achievement at the top than at the middle and at the bottom of the performance distribution (Hypothesis H₂).

However, parents may also allocate resources between siblings in an endeavour to equalize their educational outcomes (Griliches, 1979; Behrman, Pollak and Taubman, 1982; Conley, 2008a). Parents may compensate for siblings' different abilities by investing more in low-performing children. This process may also be socioeconomically stratified. Conley (2008a) has developed a theoretical model predicting that socioeconomically advantaged families compensated for ability differences between siblings whereas their socioeconomically disadvantaged counterparts reinforced these differences. According to this theory, we should observe a stronger association between family background and low academic performance than between family background and high academic performance (Hypothesis H₁).

Empirical evidence about parental responses to differences in siblings' or twins' birth endowments or early abilities is ambiguous. Studies comparing parents' responses to differences in siblings' birth weights (used as a measure of birth endowments) have found compensatory responses in families with high levels of parental education, but reinforcing responses in families with less-educated parents in the United States (Hsin, 2012; Restrepo, 2016). These findings are in line with the notion of a more pronounced association between family socioeconomic background and children's educational performance at the bottom of the performance distribution. However, in their analysis of differences in early abilities between twins in the United States, Grätz and Torche (2016) have found that socioeconomically advantaged families reinforced differences in early abilities whereas their socioeconomically disadvantaged counterparts did not respond to differences in early abilities among their twins. If parents responded to ability differences in this way, we expect socioeconomic differences in educational performance to be larger at the top than at the bottom or at the middle of the performance distribution (Hypothesis H₂).

Because of these diverging theoretical expectations and previous empirical findings, it is unclear where in the performance distribution socioeconomic differences will be strongest. Processes at play between and within families may influence our results. Our analysis does not aim to disentangle the contributions of these processes, as we are only interested in obtaining a descriptive picture of the shape of socioeconomic differences in children's performance across the performance distribution. When interpreting the results, however, we must bear in

mind that any observed variation reflects processes occurring between and within families.³

Although previous research on the intergenerational transmission of educational advantage has largely neglected that the relationship between the parents' and their children's education may vary for children with different levels of academic performance, studies from economics have found intergenerational income mobility to vary across the distribution of the offspring's income (Eide and Showalter, 1999; Grawe, 2004; Bratsberg *et al.*, 2007; Raitano, Vittori and Vona, 2016; Schnitzlein, 2016; Gregg, Macmillan and Vittori, 2019). Similar non-linearities may exist in educational mobility. We are aware of two studies which provided such estimates. Wiborg (2017) used unconditional quantile regression models to study the association between parental wealth and children's school grades in Norway, finding a stronger association between parental wealth and educational performance at the bottom and at the middle than at the top of the performance distribution. In addition, a study on Germany found that language competences at age 5 showed a similar pattern of stronger socioeconomic differences for low levels than for high levels of language competences using parental occupation, parental education, and parental income to measure socioeconomic resources (Linberg and Wenz, 2017). We add to this literature by systematically estimating socioeconomic differences in the shape in the performance distribution using different indicators of family background with data on adolescents' achievements from different countries.

Variation across Different Indicators of Family Socioeconomic Background

Research on the intergenerational transmission of educational advantage has used numerous indicators to measure family socioeconomic background, including parental education, occupation, earnings, and wealth. Lazarsfeld (1939) has argued that different measures of family background could be used interchangeably. Theoretical justification for this approach may be found in the notion that different indicators of family background measure the same underlying, unobserved concept (Conley, 2008b).

Several authors have questioned the accuracy of this simple model for both theoretical and empirical reasons. Theoretically, researchers have argued that different indicators of family socioeconomic background capture different mechanisms underlying the intergenerational transmission of educational and socioeconomic advantages (Blau and Duncan, 1967; Bukodi and Goldthorpe,

2013; Mood, 2017). Empirically, these studies showed net associations between various indicators of family background and children's outcomes while conditioning on the other indicators.

On the one hand, operationalizing family background in several ways using measures of parental education, occupation, earnings, and wealth can be understood as a test for the generalizability of our results to different measures of social origin. On the other hand, different measures of social origin measure similar but not identical concepts. In addition, measurement error may vary across different measures of social origin. What is more, there are also theoretical reasons to expect differences in the variation in the association between family background and educational performance across the performance distribution in terms of different indicators of family socioeconomic background. We can speculate that the associations between parental earnings and, in particular, between parental wealth and children's educational performance may be different from the associations between the other indicators of family background and child education; this is because earnings and wealth are more unequally distributed within societies than education and occupation (Hällsten and Pfeffer, 2017; Wiborg, 2017). For this reason, we may expect stronger variations in the associations between parental earnings/wealth and children's educational performance than between parental education/occupation and children's educational performance.

In our empirical analysis, we are interested in the gross associations between each indicator of social origin and children's educational performance. We are not interested in conditioning on the other dimensions of family background when estimating the association between one indicator of family background and children's education as this has often been done in previous research (Blau and Duncan, 1967; Bukodi and Goldthorpe, 2013; Mood, 2017). Comparing the gross associations between different indicators of family background will allow us to compare the variations in the associations between these indicators and children's educational performance in a purely descriptive way.⁴

Cross-National Variation in the Association between Family Socioeconomic Background and Children's Education

While there is general agreement that family background is a strong predictor of children's educational outcomes in all developed countries, it is unclear to what degree the intergenerational transmission of educational

advantage varies across countries. There is a part of the literature on educational inequalities that assumes that there are large cross-country differences in educational mobility (Pfeffer, 2008, 2015; van de Werfhorst and Mijs, 2010). However, some authors have argued that there is little or no substantive variation in intergenerational mobility across countries and that any variation is due to random influences and errors in measurement (Erikson and Goldthorpe, 1992; Clark, 2014). These authors have claimed that there is little variation in social mobility across advanced, industrialized societies.

Much research has investigated cross-national variation between different measures of social origin and children's education. Pfeffer (2008, 2015) used data on 20 countries from the International Adult Literacy Survey (IALS) to analyse the associations between parental education and adult literacy, as well as final educational attainment. He used the *unidiff* parameter of log-linear models to compare cross-national variation. Using data from the Progress in International Reading Literacy Study (PIRLS) and the Programme for International Student Assessment (PISA), Chmielewski and Reardon (2016) have found variation in the association between family income and academic performance across 20 countries. In most of the countries included in their study, however, the variation within countries was greater over time than the variation across countries. Bradbury *et al.* (2015) have argued that there is a stronger association between parental resources and children's cognitive skills in the United States than in Australia, Canada, and the United Kingdom.

Our study is the first to analyse whether the pattern of variation in socioeconomic differences in educational performance for low-, middle-, and high-performing children varies across countries. This adds depth to the cross-national comparisons of mean (or conditional mean) differences in educational performance according to family background that previous research has reported.

We expect that the same family strategies exist in Germany, Norway, and the United States. However, the specific institutional features of the education and welfare regimes of each country may shape the degree to which these family strategies influence children's educational performance. On the one hand, the more egalitarian features of the Norwegian education system (e.g., no tracking at an early age and a higher proportion of the population attending institutions of higher education) may lead to a weaker relationship between social origin and children's performance at the top of the performance distribution. On the other hand, less variation in socioeconomic differences in the shape of the

performance distribution could also be a result of earlier between-school tracking in Germany than in the two other countries. Because early tracking may be influenced less by students' educational performance and more by parental preferences (i.e., family socioeconomic background), there may be less variation in socioeconomic differences in academic performance between low-, middle-, and high-performing children in Germany than in the two other countries.

Data and Methods

Data and Sample Selection

Data for Germany, Norway, and the United States are used. The data sources which we employ are often used to study the intergenerational transmission of educational advantage in these countries. The data for Germany come from the German Socio-Economic Panel Study (SOEP) (Wagner, Frick and Schupp, 2007), a nationally representative household panel study; we use version 34 (DOI: 10.5684/soep.v34) of the data. This version includes information from all previous waves. For the United States, we use all the current waves available (1997, 2002, 2007, and 2014) from the Child Development Supplement (CDS) module of the Panel Study of Income Dynamics (PSID). The Norwegian data are derived from administrative registers containing complete individual-level records for the whole population. We harmonize the data and measures across these countries to make the data comparable.

The Norwegian data include 473,209 respondents born 1985–1995. We observe their school grades for 2002–2011. The analytical sample for the German data includes 2,989 respondents born 1987–2000 and whose cognitive skills were measured between 2006 and 2017. The data from the United States include 3,569 respondents born 1984–2004 and observed 1997–2012 aged 10–18. Some children in the PSID data were observed in multiple waves; the most recent observation for each child is used.

Measures

Academic performance

In the Norwegian data, the dependent variable is the average school grade in secondary school at age 16. In Germany, academic performance is measured by a cognitive skills test conducted as part of the survey when respondents were aged 17. These measures are not identical but they are comparable. Previous research has shown that school grades and achievement tests are

highly correlated within countries and thus likely to capture the same underlying concept (Borghans *et al.*, 2016).⁵ Because of tracking in the German education system, using a cognitive skills measure is the only means available to rank all respondents in Germany on a common metric. In the United States, academic performance is measured through the Woodcock–Johnson rescaled test when respondents were aged 10–17. This test of cognitive skills consists of three dimensions: letter-word recognition, passage comprehension, and applied problem-solving skills. The Cronbach's alpha between these dimensions is 0.86. We age-standardize the scores and compute average scores across all three dimensions. In all three countries, we standardize the measures of academic performance to have a mean of 0 and a standard deviation of 1.

Family socioeconomic background

Family background is measured in four ways. First, we use parental education, measured as the highest level of education attained by either parent. A continuous version of this variable is used, years of education. This measure corresponds to the years needed to complete the highest degree a respondent's parent holds. We standardize this measure to have a mean of 0 and a standard deviation of 1.

Second, a measure of parental occupation is used, measured in each country by constructing a continuous measure of occupational status. The International Socio-Economic Index of occupational status (ISEI) is used for this purpose. In Germany, the measure refers to parental occupation when parents' children were around 15 years old. In Norway, it was measured as the parents' most frequent occupation in the period 2003–2008, and in the United States from 2002–2007. Again, we take the highest value of either parent. We standardize the resulting measure to have a mean of 0 and a standard deviation of 1.

Third, in Norway and in the United States we use measures of parental earnings. We do not have this information available for our German data. Hence, we report results for the association between parental earnings and academic performance only for Norway and the United States. In Norway, we use the sum of mother's and fathers' average earnings during the time when their children were 10–16 years old. In the United States, we use information on the total family earnings, based on the parents' wages and self-employed earnings, measured in and averaged across 1997 to 2006. To account for the skewed distribution of earnings, we estimate the relative placement of individuals in the

earnings distribution by dividing the distribution into 100 percentiles. In line with the other measures of family background, we standardize parental earnings to have a mean of 0 and a standard deviation of 1.

Fourth, parental wealth is used as a measure of social origin based on parental net value, calculated as gross wealth minus debt. In Germany, parental wealth was measured for both parents in 2002, 2007, and 2012. We use the sum of the father's and mother's wealth in each survey wave. In the United States, we use the average family net wealth for 1999–2007. In Norway, we use the sum of the mother's and father's average net wealth when their children were aged 10–16. Similar to earnings, parental wealth is a highly skewed continuous variable; in addition, net worth also consists of many negative values and zeros. We therefore apply a percentile rank and standardize the resulting measure to have a mean of 0 and a standard deviation of 1.

We report the correlations between the different indicators of family background in [Supplementary Table S5](#).

Control variables

The analysis provides descriptive estimates of the gross associations between our four indicators of family socioeconomic background and academic performance. We therefore estimate quantile regression models without including any control variables. We test the robustness of our results by including gender and minority background as control variables. Minority background is defined in different ways in the different countries included into our analysis in order to take into account country-specific aspects. In Germany and Norway, minority background refers to migration background, which is defined as one if a respondent or one of his/her parents was born outside Germany. In the United States, we control for dummy variables for separate groups of African-Americans, Hispanics, and others compared to Whites as the reference category. We also report separate results for male and female respondents below.

Descriptive statistics of the variables included in the analysis are reported in [Table 1](#).

Methods

Our study tests whether the association between family socioeconomic background and children's academic performance varies across low-, medium-, and high-performing children. Ordinary least squares (OLS) regression models assess this association only at the conditional mean. To assess different parts of the distribution of the dependent variable, we therefore apply

Table 1. Descriptive statistics

	Germany			Norway			United States		
	M	SD	N	M	SD	N	M	SD	N
Academic performance	0.00	1.00	2,989	0.00	1.00	473,209	0.00	1.00	3,569
Female	0.49	0.50	2,989	0.49	0.50	473,209	0.50	0.50	3,569
Parental education	0.00	1.00	2,943	0.00	1.00	471,568	0.00	1.00	3,567
Parental occupation	0.00	1.00	2,902	0.00	1.00	438,708	0.00	1.00	2,492
Parental earnings	—	—	—	0.00	1.00	473,152	0.00	1.00	3,568
Parental wealth	0.00	1.00	2,989	0.00	1.00	473,077	0.00	1.00	3,560

Sources: Germany: Socio-Economic Panel Study (SOEP), v34 (DOI: 10.5684/soep.v34). Norway: Registers. United States: Panel Study of Income Dynamics (PSID).

conditional quantile regression models (Koenker and Bassett, 1978; Hao and Naiman, 2007).

Quantile regression models are perhaps most often used to shed light on the median rather than the mean of the dependent variable in the presence of extreme outliers. While extreme outliers are not present in our study, another advantage of the quantile regression framework is that it allows researchers to study location shifts in the associations between covariates and the dependent variable at specific points of the distribution of the dependent variable (Hao and Naiman, 2007: 5). These models thus allow us to assess the associations between different measures of social origin and academic performance at specific quantiles of the distribution of academic performance. In contrast to OLS, the estimator of the conditional quantile regression models rely on minimizing absolute deviances in the sums of residuals (rather than the squared sums of residuals). The quantile regression estimator is more computer intensive than OLS and relies on linear programming.

We use conditional quantile regression models in our main analyses, in which we only include one predictor of social origin at the time. In addition to the descriptive goal of our analyses, some authors have criticized the use of conditional quantile regression models when including more than one independent variable, because the covariates (including the control variables and the residuals), are redefined at specific quantiles of the dependent variables. Some researchers argue that unconditional quantile regression models tackle this issue and that they should be used in analyses that include several independent variables (e.g., Killewald and Bearak, 2014). One popular version of these unconditional quantile regression models defines the dependent variable prior to the regression procedure, using the re-centered influence function, RIF (Firpo, Fortin and Lemieux, 2009). Therefore, RIF-covariates will retain their

interpretation across the distribution of the dependent variable, regardless of including more covariates. We use these models in robustness checks.

In our main analyses, however, we estimate models that include only one independent variable and conditional quantile regression models are the preferred option for these. In a robustness check, we estimated conditional quantile regression models that control for background characteristics such as gender and minority background (see Supplementary Figure S1 and Table S3). These models led to the same conclusions about variation in socioeconomic differences across the outcome distribution as the conditional quantile regression models with no controls. Given the correlation between minority background and social origin, it is not surprising that in Germany and the United States associations between social origin and academic performance are lower once we control for minority background and gender. However, for our research question the important point is that the shape of socioeconomic differences in academic performance across the performance distribution is unaffected by these controls.

The Supplementary data also reports comparisons between the conditional and unconditional quantile regression models.⁶ These additional analyses confirm that conditional quantile regression models are appropriate for our analyses, as they provide nearly identical results.

Results

Figure 1 reports the main findings of our analysis. It is divided into four panels, showing the variation in the association between our four indicators of family background and children's educational performance across 10 quantiles of academic performance in each country. The point estimates and standard errors of the quantile

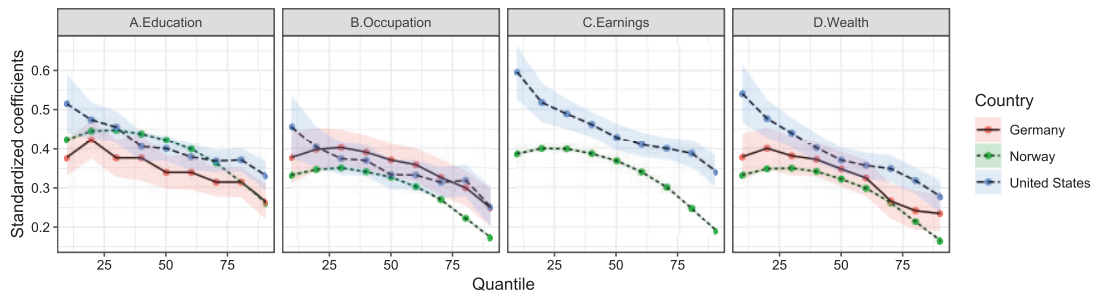


Figure 1. Quantile regression models estimating the associations between different indicators of family background and educational performance in Germany, Norway, and the United States

Note: 95% confidence intervals based on robust standard errors.

Sources: Germany: Socio-Economic Panel Study (SOEP), v34 (DOI: 10.5684/soep.v34). Norway: Registers. United States: Panel Study of Income Dynamics (PSID).

regression models on which this figure is based are reported in Supplementary Table S1.

The first panel of Figure 1 shows the association between parental education and children's educational performance (Figure 1A). Overall, this association follows an almost linear decline across the 10 quantiles of the performance distribution. In all three countries, the association between parental education and children's educational performance is strongest at the bottom and weakest at the top of the performance distribution. In the United States, the decline is steeper than in Germany and Norway. For most parts of these distributions, however, the patterns are virtually identical in Germany, Norway, and the United States. In all three countries, the differences between the associations at the lowest and at the highest quantiles are substantial. At the 10th quantile, each standard deviation increase in parental education is associated with a between 0.38 (Germany) and 0.52 (United States) standard deviation increase in academic performance. At the 90th quantile, each standard deviation increase in parental education is associated with a between 0.26 (Germany and Norway) and 0.33 (United States) standard deviation increase in academic performance. The association between parental education and academic performance is about one-third weaker at the top than at the bottom of the performance distribution in all three countries.

Figure 1B reports the variation in the association between parental occupation and academic performance across the performance distribution. The findings are nearly identical to those observed for parental education. In all countries, there is a continuous decline in the association between parental occupation and academic performance across the performance distribution. Again, this decline is most pronounced in the United

States. In the United States, a one standard deviation increase in parental occupation is associated with a 0.46 increase in academic performance at the 10th quantile, but only with a 0.25 standard deviation increase at the 90th quantile, i.e. the association between parental occupation and academic performance is reduced by nearly one-half across the performance distribution. A slightly less pronounced but largely similar pattern is observable in Germany and Norway.

With respect to parental earnings as a measure of family background (Figure 1C), we find a continuous decline in the association between them and academic performance across the performance distribution in both Norway and the United States. Due to data limitations, we do not have an indicator of parental earnings in Germany. The gap between Norway and the United States in the strength of the association between family background and academic performance is larger for earnings than for education, occupation, or wealth. The pattern of variation in the association between parental earnings and children's academic performance is, however, very similar across both countries. In Norway, a one standard deviation increase in parental earnings is associated with a 0.39 standard deviation increase in academic performance at the 10th quantile, but with only a 0.19 standard deviation increase at the 90th quantile. In the United States, the association between parental earnings and educational performance decreases from 0.60 at the 10th to 0.34 at the 90th quantile. In both countries, the association between parental earnings and educational performance is nearly twice as large at the bottom than at the top of the performance distribution.

Finally, with respect to parental wealth (Figure 1D), there is a continuous decline in all three countries in the

association between parental wealth and educational performance across the performance distribution. In line with the results for parental earnings, there is a larger gap in the bottom quantile between the United States and the other countries. At the 10th quantile, a one standard deviation increase in parental wealth is associated with a 0.54 standard deviation increase in academic performance in the United States, but with a 0.33 standard deviation increase in Norway and a 0.38 standard deviation increase in Germany. At the top of the performance distribution, however, the association between parental wealth and educational performance is of a similar strength in all countries. At the 90th quantile, the association between parental wealth and academic performance is 0.16 in Norway, 0.23 in Germany, and 0.28 in the United States. Nevertheless, the overall pattern of a decline in the association between parental wealth and academic performance by around one-half across the performance distribution occurs in all three countries.

In addition to cross-national differences, we also analyse gender differences in the variation between family background and academic performance across the performance distribution. Such differences can emerge if the influence of family background on children's education varies by gender (Entwisle, Alexander and Olson, 2007). Since such interactions could exist in our case, we examine whether the associations between family background and children's educational performance vary differently for male and female children whose performance is low, middle, or high. Figure 2 reports conditional quantile regression models predicting academic performance separately for male and female respondents. The point estimates and standard errors of these models are reported in Supplementary Table S2.

The findings show that for both male and female children, socioeconomic differences in academic performance vary in a similar way across the shape of the performance distribution. Independent of gender, the association between family socioeconomic background and children's educational performance decreases in all three countries across the performance distribution. Nevertheless, the size of the association between family background and academic performance is not the same for male and female children for each quantile.

In the Norwegian case, we can also find evidence of small differences in the degree to which the association between family background and academic performance varies across the distribution for male and female children. For instance, the association between parental education and academic performance for males is 0.44 at the 10th and 0.24 at the 90th quantile. For females,

the difference is 0.41 at the 10th and 0.30 at the 90th quantile. Accordingly, there may be less variation in socioeconomic differences in the shape of the performance distribution for girls than for boys.

Because of the smaller sample sizes, there is more uncertainty involved in comparing male and female respondents in Germany and in the United States. These countries, however, show the same pattern of gender differences as Norway. Despite these gender differences, the overall pattern of a decrease in the association between family background and academic performance across the performance distribution applies to both male and female respondents.

Discussion and Conclusion

In this study, we have tested whether socioeconomic differences in academic performance vary across children with low, middle, and high academic performance. Theories about mechanisms underlying the intergenerational transmission of advantage and theories about the resource allocation within families predict such variation. Using high-quality data from three countries with different welfare and education regimes (Germany, Norway, and the United States), the empirical analysis revealed that socioeconomic differences in academic performance were smallest at the top and largest at the bottom of the performance distribution, no matter which measure of family background was used. These findings were observed for both male and female children.

Smaller socioeconomic differences in academic performance for high-performing children are not in line with expectations that such children profit most from parental resources in a process of cumulative advantage (DiPrete and Eirich, 2006). Instead, our results are in line with predictions derived from theories arguing that families aim at avoiding social downward mobility (Boudon, 1973; Breen and Goldthorpe, 1997; Jackson, 2013; Bernardi and Cebolla-Boado, 2014). These results are also consistent with theories suggesting that resources are distributed within families to equalize outcomes between siblings (Behrman, Pollak and Taubman, 1982; Conley, 2008a; Griliches, 1979). We cannot distinguish between these two mechanisms in this study, as samples of siblings in Germany and the United States are too small to apply quantile regression models with family fixed effects. Further research is needed to test the extent to which these different mechanisms underlie the variation of socioeconomic differences in academic performance for children whose performance is low, average, or high.

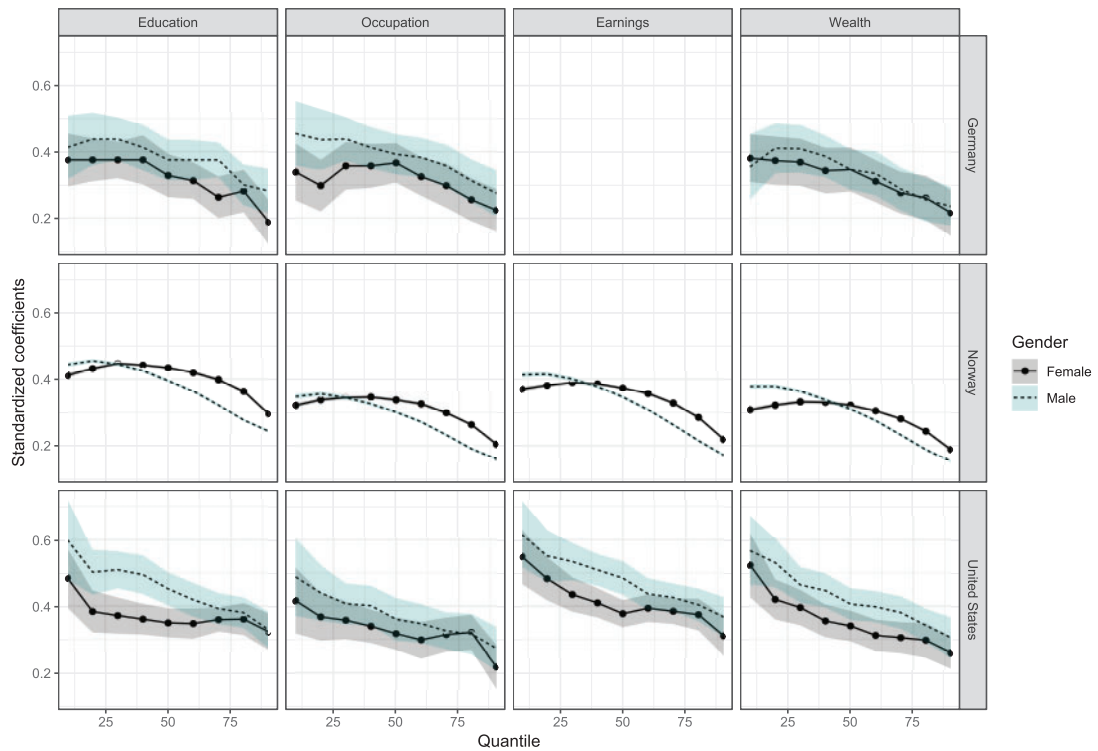


Figure 2. Quantile regression models estimating the associations between different indicators of family background and educational performance in Germany, Norway, and the United States by gender

Note: 95% confidence intervals based on robust standard errors.

Sources: Germany: Socio-Economic Panel Study (SOEP), v34 (DOI: 10.5684/soep.v34). Norway: Registers. United States: Panel Study of Income Dynamics (PSID).

The finding of a weaker association between family background and academic performance at the top of the performance distribution adds a new insight to theories of social mobility. If families behave to avoid downward social mobility (within and/or between families), they do not only influence educational decision-making (sometimes referred to as ‘secondary effects’) (Boudon, 1973; Jackson, 2013); it also seems that parents influence children’s academic performance (‘primary effects’ [Boudon, 1973; Jackson, 2013]). This behaviour has crucial implications for research on social mobility, particularly because it leads low educational performance to be less consequential for children from socioeconomically advantaged families than for children from socioeconomically disadvantaged families (Bernardi, 2014; Bernardi and Grätz, 2015).

A further contribution of our study was to analyse cross-national differences in intergenerational educational mobility. To the best of our knowledge, ours is

the first study to compare the variation in socioeconomic differences in academic performance between children with low, medium, and high academic performance across countries. Even though we have focused on three countries with different welfare (Esping-Andersen, 1990) and education regimes (Allmendinger, 1989; Busemeyer and Nikolai, 2010; van de Werfhorst and Mijs, 2010) and different levels of educational inequality (Shavit and Blossfeld, 1993; Pfeffer, 2008, 2015), we did not find substantial cross-national differences. Not only the strength of the association between family background and academic performance, but also the shape of socioeconomic differences across the performance distribution, are very similar in Germany, Norway, and the United States. These findings support the notion of limited variation in the way family background affects educational outcomes across advanced, industrialized countries. Of course, evidence based on only three countries will always be limited; it would therefore be

desirable to see our approach applied to a larger set of countries representing different types of welfare and education regimes.

In addition, we assessed whether the associations between social origin and children's educational performance varied across different indicators of family background. We found virtually identical results for the various indicators of family background, both in the effect sizes and in the shape of socioeconomic differences across the performance distribution. Our results therefore support the view that, at least with respect to the intergenerational transmission of educational advantage, different indicators of family background capture the same underlying concept (Conley, 2008b). Our findings are in line with the results reported by previous research on Norway (Wiborg, 2017) and Germany (Linberg and Wenz, 2017).

Despite the limitations of our analysis, our study demonstrates that there is indeed variation in the shape of socioeconomic differences across the performance distribution. Future research on educational mobility should account for these non-linearities: as we have shown, focusing on the associations between family background and children's educational performance at the mean can misrepresent the true underlying relationships. The pattern of variation in the associations between family background and academic performance seems to be similar across advanced, industrialized countries.

These findings put at centre stage the question of which mechanisms underlie this variation. We did not investigate these mechanisms in our descriptive study. For instance, researchers could wish to distinguish between parental responses to birth endowments and parental responses to academic performance at a later age. They could also be interested in studying whether parental responses change the relationship between birth endowments and later academic performance. These questions are certainly important but they are beyond the scope of the present study.⁷

Our results suggest that these mechanisms transcend national contexts and are likely to be located at the family level. Socioeconomically advantaged families primarily influence the performance of their low-performing children. Therefore, policies focusing on low-performing children may be particularly effective in reducing inequality of educational opportunity.

Notes

1 We use the terms educational performance and academic performance interchangeably.

- 2 Our study is not causal but descriptive. For that reason, we do not use causal language throughout this manuscript. We only use the terms 'primary effects' and 'secondary effects' because they are used by authors in this literature (Jackson, 2013). We, however, like to point out that most studies in this literature are descriptive and strictly speaking a causal terminology should not be used.
- 3 Socioeconomic differences in the shape of the performance distribution may also be caused by school resources having different effects for children whose performance is low, average, or high. School resources are likely to be correlated with family background. The aim of our study is not to distinguish between these explanations, but to draw attention to the so-far largely neglected variation in the association between family background and academic performance across the performance distribution. In our view, however, parents choose their children's schools by changing their place of residence, by deciding which schools their children attend, or by paying school fees. School resources are therefore mediating variables of the parental strategies emphasized in our theoretical framework.
- 4 Adding several indicators of family background to the same model requires precise ideas about the causal relationships between these variables. For instance, it is doubtful whether it is fruitful to control for parental earnings, wealth, and occupation when estimating the association between parental and children's education. Parental earnings, wealth, and occupation are likely to be mediating variables of parental and children's education, i.e. variables lying on the causal path connecting parental and children's education. Therefore, models which include several indicators of family background introduce overcontrol bias and do not identify the effects of each indicator of family background on children's education (Elwert and Winship, 2014). In addition, given the high likelihood that key confounding variables remain unobserved, any approach that relies on selection of observed variables is unlikely to identify the causal effects of different indicators of family background on children's education even when specifying a correct model that relates the different indicators of family background to each other. Due to these challenges that any analysis aiming to identify the causal effects of different indicators of family background on children's education will have to tackle, our analysis focuses on the descriptive, gross estimates between parental education, earnings, occupation, and wealth and children's education. We

thus follow Torche's (2015) appeal to focus social mobility research on the description of variation in bivariate mobility estimates across contexts. Although this approach is descriptive, it is theoretically informative as it sheds light on competing theories explaining the intergenerational transmission of education, the variation in this transmission across different indicators of family background, and its variation across countries.

- 5 We acknowledge that the slight differences in measures of academic performance across countries is a limitation in our cross-national comparison. However, because we find virtually no variation across countries in the variation between family background and academic performance across the performance distribution, these measurement differences are unlikely to affect our conclusions.
- 6 We compared conditional and unconditional quantile regressions with only one independent variable, i.e. no control variables (Supplementary Figure S2 and Table S4). In Norway and Germany, these unconditional quantile regression models provided, as we would expect, the same results as conditional quantile regression models. In the United States, however, the unconditional quantile regression models differed in some instances from the conditional ones. As these models should produce identical estimates without control variables, we have some concerns about the unconditional quantile regression models and therefore focus on the conditional ones in our analysis.
- 7 For the purpose of our analysis, i.e. to provide estimates of socioeconomic differences in academic performance, it is important not to condition on birth endowments, as those are affected by social origin. Conditioning on birth endowments, therefore, introduces overcontrol bias when estimating the association between social origin and academic performance (Elwert and Winship, 2014). But controlling for birth endowments is also less likely to shed light on any selection issue leading to the observed patterns in our analyses. It is reasonable to assume that birth endowments are normally distributed. Even when breaking down social categories according to the parents' high and low social positions, it is reasonable to assume that the birth endowments for each of these categories are equally, normally distributed around their respective means. Assume that you calculate the difference between the 10th quantile for those with high and low family background and assume that you calculate the same differences at the 90th quantile. These two

differences will be identical, and thus provide uniform estimates of the social background across the performance distribution. To create the observed patterns in our analyses, the shape of the distributions of academic performances needs to vary by family background, for example be more non-normally skewed for certain social categories. So, the patterns in our analyses cannot be explained by differences in birth endowments (assuming that these are equally, normally distributed), but have to be influenced by parents and other, post-birth environmental factors.

Supplementary Data

Supplementary data are available at *ESR* online.

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