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ABSTRACT

Overeducation and Economic Mobility*

We assess the hypothesis that declining intergenerational economic mobility in Norway is attributable to a rising signaling value of education accompanied by more overeducation particularly among upperclass offspring. We identify five empirical facts that together point in this direction:

• The educational earnings premium has risen, but only through the extensive (employment) margin.
• The earnings premium has increased more when education is measured as years corresponding to completed degrees than when measured as time actually invested.
• Both educational attainment and the labor market's skill-requirements (as predicted by the occupational distribution) have increased, but attainment has risen faster than requirements such that the incidence of overeducation has increased.
• There is a steep positive social gradient in overeducation: Overeducation is more frequent and has risen faster among offspring in upper-class families.
• There is a steep negative social gradient in non-employment: Non-employment is more frequent and has risen faster among offspring in lower-class families.

JEL Classification: I21, I26, J24, J62

Keywords: overeducation, intergenerational mobility, returns to education, signaling

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1 Introduction

Over the past decades, educational achievement has become a considerably more important ingredient of economic success. In the US and some other developed countries, this trend has materialized in the form of a rise in the college wage premium (Goldin and Katz, 2008; Fortin et al., 2011; Autor, 2014). In Norway, as we show in the present paper, it has primarily materialized in a stronger association between education and employment propensity. Regardless of the way it plays out, a potentially important, but often disregarded consequence of higher returns to education is that it also implies higher "returns" to family background.[1] Empirical evidence has shown that family support and encouragement are vital inputs in the production of educational outcomes and that lower-class families provide less such encouragement and support (Guryan et al., 2008; Kalil, et al., 2012; Doepke and Zilibotti, 2019; Mayer et al., 2019; Flood et al., 2022). In particular, it has been documented that economically advantaged parents on average produce more cognitively stimulating home learning environments, and spend more time supporting their children's education. Ceteris paribus, this implies that as educational attainment becomes a more critical ingredient of economic success, the handicap of being born into a less resourceful family increases, and the economic mobility out of the lower classes declines.

In Norway, recent empirical evidence also suggests that intergenerational economic mobility has indeed declined, particularly at the bottom of the parental earnings rank distribution (Markussen and Røed, 2020; Hoen et al., 2021). To illustrate, Figure 1 shows, for the 1973-1992 birth cohorts, how people born into the bottom decile of the parental earnings distribution have performed in terms of own adult (age 30) earnings rank and employment propensity, with and without conditioning on own educational attainment. Bottom class offspring have fallen more and more behind, both in terms of earnings rank and employment propensity. However, when we control for own educational attainment, the relative decline of the bottom class becomes considerably smaller. Education thus seems to be an increasingly important mediator of intergenerational earnings persistence. Declining economic mobility and rising returns to education may be two sides of the same coin.

How should policy-makers react to these developments? Education is known to play two distinct roles in the labor market; to *enhance* productivity (Becker, 1964) and to *signal* productivity (Spence, 1973). To the extent that that the rising returns to education emanates from its productivity-augmenting effects and thus mirrors increased social returns, the resultant decline in economic mobility should arguably be fought by focusing on means that can improve the educational outcomes for lower class offspring. However, in a labor market with competition for jobs, it is possible that workers invest more time and effort in education than what is socially optimal (Caplan, 2018). By investing in education, a person may improve his/her *rank* in the job queue by pushing other potential workers down to a lower rank (Moen, 1999). If this externality is important, policies aimed at raising the population's education level may inadvertently reduce economic mobility, as it adds steam to a socially skewed signaling game. In that case, the appropriate answer may be to facilitate less socially biased and less costly ways of signaling willingness and ability to work.

[1] There is a related literature studying the intergenerational mobility of education, indicating that the expansion of higher education have disproportionately favored offspring from richer families; see, e.g., Blanden and Machin (2003) and Blanden et al. (2004) for evidence from the UK and Karlson and Landersø (2021) for more recent evidence from Denmark.

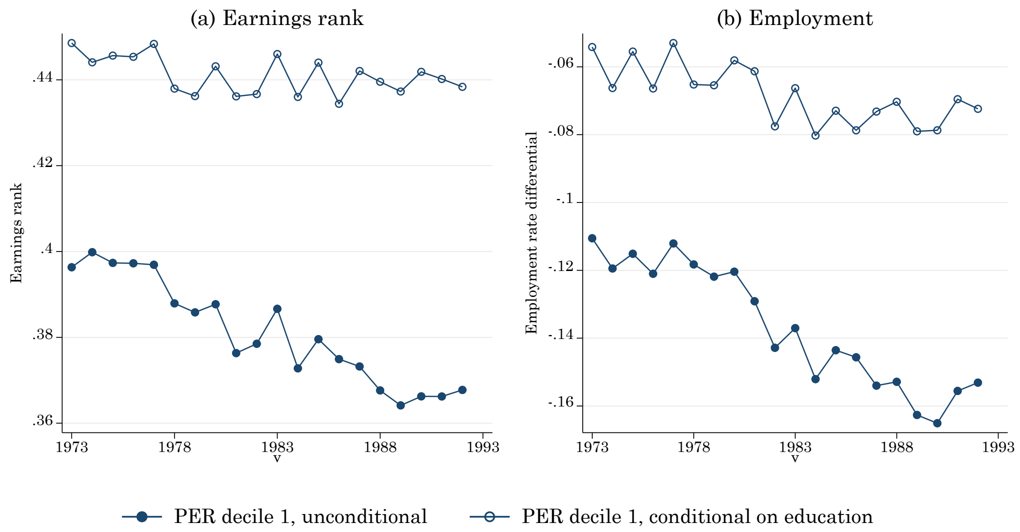

Figure 1. Earnings rank and employment differentials for people born into the bottom decile of the parental earnings distribution in Norway. With and without conditioning on own educational attainment. By birth year.
Note: In panel (a), the offspring's earnings rank is measured at age 30 on a uniform [0,1] scale. Parents are ranked into deciles based on earnings obtained during age 52-58 (three best years); see Section 2.3 for details. The employment differential in panel (b) is the employment rate for offspring born in the bottom class minus the average employment rate for the whole cohort. Employment is defined as having annual earnings above 1 "Basic Amount" (BA) (NOK 118 620 in 2023). This threshold corresponds to approximately 18% of average earnings in a full-time-full-year job. Educational attainment is controlled for by three-digit ISCED (International Standard Classification of Education).

To assess the hypothesis that intergenerational mobility has been held back by elements of overeducation and inefficient rank competition, we examine the distribution of educational attainment and the associated earnings premiums within and across narrowly defined occupations for all people born in Norway from 1973 through 1992. The analysis is based on labor market status observed at age 30 or 32, with all educational activities and achievements measured up to age 29. There is a large existing literature about overeducation addressing both its prevalence and its earnings consequences, primarily from a descriptive viewpoint; see, e.g., Groot and Van den Brink (2000), McGuinness (2006) and Leuven and Oosterbeek (2011) for surveys.[2] We contribute to this literature by introducing the class (family background) perspective and by suggesting some new strategies for identifying the required education for each occupation.

Common ways of defining overeducation build on taking the modal or average attainment level within occupations as indicators of required education, and interpret education beyond these levels as overeducation (in cases average attainment is used as the point of departure, with some margin,). For typical low-skill occupations, these strategies become awkward as the overall rise in educational attainment in the population almost by construction imply a rise in estimated requirements. In particular, in today's mass-education environment, no (or very few) occupations will have "no post-compulsory education" as the modal attainment level. Hence, to identify the minimum educational requirements in each occupation, we instead use as our main strategy a definition based on the highest observed attainment level needed to account for a considerable fraction (specified as 30%) of newly hired workers. Overeducation then takes the form of higher (or more) education than what we estimate is required

[2] There is also a literature focusing on the influence of overeducation on job satisfaction, health problems, and premature labor market exit, which we do not discuss here; see, e.g., Vieira (2005), Garcy (2015), and Bender and Heywood (2017).

in the occupation. Interpreted this way, overeducation is not necessarily wasted education, and it may (or may not) contribute to raise within-occupation productivity.

In the descriptive part of our paper, we show that both actual attainment, required education, and overeducation have increased over the two decades covered by our analysis. The fraction of employees that are overeducated by age 30 (as defined by their highest completed degree) has risen from 34 to 40 percent. The level as well as the rise of overeducation are strongly and positively associated with parental earnings rank, suggesting that the effort cost of education is higher for offspring with a disadvantaged family background. The trends in the class-structure of overeducation are consistent with a "bumping-down story" whereby overeducated offspring from the middle and upper classes outrank less educated people from the lower classes in the competition for a declining number of available low-skill jobs.

Our paper also contributes more broadly to the returns-to-education literature. First, whereas most of the existing literature is preoccupied with identifying the returns to education conditional on employment, we aim at examining how the educational earnings premium can be decomposed into its different sources of employment propensity (the extensive margin), occupational choice, and earnings within occupation. Second, in addition to measuring education in terms of normed years associated with the highest completed degree, as is common in the literature, we use information about additional credits obtained (without raising the "highest obtained") and about total time actually spent in education. The difference between economic rewards to educational degrees and to the time actually invested in education is sometimes referred to as the sheepskin effect, and interpreted as the signaling value of education.

Given the non-random selection into education, estimated earnings premiums do not have a clean returns-to-investment interpretation. While it is hard enough to find appropriate instruments for the various margins of educational attainment, it is all but impossible to also find valid instruments for actual time spent and for required attainment in the (endogenously) chosen occupation. Hence, a pure causal returns-to-education analysis seems out of reach. We use family-fixed effects to mitigate the selection problem, and for some of the cohorts studied (those born from 1986 through 1988), we exploit data on unusually informative human capital controls, such as IQ test scores and grade point averages from junior high school, in addition to parents' earnings ranks. While we cannot rule out remaining selection problems, we use these controls to examine the sensitivity of the identified earnings-education-associations with respect to heterogeneity in predetermined human capital endowments.

Examining the empirical association between educational attainment and annual earnings at age 30, we find that the high-school premium has risen considerably over time, whereas the added college premium has remained stable. Moreover, when we decompose the education premium into factors related to the probability of becoming employed, the choice of occupation, and individual earnings within occupation, we find that the entire rise in the premium is accounted for by a stronger association with employment propensity. Educational attainment has neither become more important for obtaining a better paid occupation nor for individual pay within occupation, but ever more critical for being employed at all.

Overall, we estimate that the earnings premium associated with one extra year of successfully completed education (confirmed by graduation) has increased from around 7% of average earnings for the

1973 cohort to 8% for those born in 1992.[3] For the latter cohort, roughly half of the premium is driven by the extensive employment margin, whereas approximately 35% is driven by occupational choice, and the remaining 15% is caused by a within-occupation earnings premium. If we instead measure education in terms of time actually spent (without conditioning on successful completion), the overall earnings premium drops by approximately 40-50% and the within-occupation premium disappears completely or becomes negative. The estimated rise in the premium almost disappears. It is notable that the returns to time spent in education is largest at the bottom of the parental earnings rank distribution. This suggests that sorting into education based on expected returns is more prominent in the lower than in the upper classes, most likely because educational decisions to a lesser extent is dictated by parental expectations.

To examine the wage premiums conditional on employment, we estimate both Mincer-type log-wage equations, where the explanatory variables of interest are alternative definitions of educational attainment, and Duncan-Hoffman-style regressions where the explanatory education variables are expressed in terms of required education, overeducation, and undereducation. Our results indicate a wage premium at age 32 of roughly 3.2% per year of education successfully leading to a higher degree, out of which 1.8% is a within-occupation effect. Considering time spent in education as the explanatory variable of interest instead cuts the total premium by half and the within-occupation premium by two thirds. Degrees corresponding to the required education in the chosen occupation give a higher premium than overeducation, but the difference is modest. Point estimates indicate approximately a 4% returns for each year of required education, a 3% returns for overeducation, and a 2% loss for each year of undereducation. The finding of a positive earnings effect beyond required attainment highlights that overeducation is not necessarily worthless education, at least not from an individual viewpoint. While a wage premium for overeducation can be rationalized by productivity-enhancement in some occupations, this appears unlikely in other occupations. However, looking more directly at education premiums by type of job, we find that completed degrees give significantly higher wages in all types of occupations, even in low skill occupations where a causal link between attainment and productivity is hard to rationalize.

Our findings may call for a reinterpretation of parts of the empirical literature on the signaling role of education. Attempts to disentangle signaling from human capital formation often builds on an analysis of how wages evolve with tenure (or work experience), as the relative influence of a signal should decline as the employer discovers the employees' true productivity; see, e.g., Farber and Gibbons (1996), Altonji and Pierret (2001), Lange (2007), and Aryal et al. (2022). However, when disentangling private and social returns to education based on this idea, it is a tacit presumption that education does not noticeably affect the probability of becoming employed in the first place. In the present paper, we show that enhancing employability is an important part of the returns to education for many individuals, and that the educational system to an increasing extent has become the de facto "gatekeeper" of the labor market. Ignoring this role of educational credentials may lead to an incomplete understanding of the private and social returns to education. Another implicit assumption behind the wage regression approach is that wages are ultimately determined by fully informed employers, such that they gravitate toward marginal productivity over time. However, at least in a Norwegian context,

[3] We relate the estimated earnings premium to average earnings in the economy, rather than to individual earnings, as the inclusion of the extensive employment margin implies that many people have zero (or very low) earnings such that an effect measured relative to own earnings has no meaning. In the subsequent analysis of wage premiums for the employed, we return to a more standard analysis of effects relative to own wage built on a log(wage) specification.

wages are in practice determined through a (partly centralized) bargaining process whereby educational credentials as well as tenure play important roles far beyond their influence on individual productivity.

This paper proceeds as follows: In the next section, we describe our data and the way we define required education, overeducation, and class background. Section 3 provides a descriptive overview of trends in education and occupational structure and Section 4 then shows how these trends have played out in the form of overeducation. Section 5 first offers a decomposition of the educational earnings premium and its trend into the different margins of employment, occupation, and within-occupation earnings. It proceeds by examining wage differentials within the framework of Mincer and Duncan-Hoffman style regressions. Finally, Section 6 concludes.

2 Data and definitions

We use encrypted administrative population data from Norway, which from 2003 provide occupational status for all employees in Norway based on the International Standard Classification of Occupations (ISCO). We identify approximately 300 different occupations in Norway. The occupation data are merged at the worker-level with educational registers that provide information about educational attainment in a sufficiently consistent fashion for all cohorts born from 1970 and onwards. To ensure comparability over time, we focus on labor market outcomes measured at a particular age. Given that occupations are identified from 2003 through 2022, we have reliable and comparable data on both occupation and education for all persons born between 1973 and 1992 when measured at age 30.

Below, we describe how we use the different data sources and how we define the concepts of required education and overeducation.

2.1 Representation of educational attainment

We divide the level of individual educational attainment into four main categories based on the highest completed degree (CD):

i) Only compulsory education (first digit in the International Standard Classification of Education (ISCED 2011) equal to 0, 1, or 2), normed to 0 non-compulsory years,

ii) High-school level (ISCED 2011 equal to 3), normed to 3 or 4 non-compulsory years,

iii) College/University at Bachelor's level (ISCED 2011 equal to 4, 5, or 6), normed to 5 or 6 non-compulsory years, and

iv) College/University at Master's level or PhD (ISCED 2011 equal to 7 or 8), normed to 8 or 11 non-compulsory years.

In addition to the highest completed degree, many individuals have taken courses that have not lead to a higher attainment level. For example, a person with only compulsory education may have taken courses at the high-school level, but without completing a valid high-school degree. A person with a Bachelor's degree may have taken courses at the master level, but without completing a Master's degree. We will characterize each person's highest completed education in terms of the four categories listed above, sometimes recoded into the number of normed non-compulsory education years. Educational attainment that has not lead to a higher completed education level, yet still added educational credit points, will similarly be measured in terms of normed years. Finally, we will characterize each person in terms of the total number of semesters registered in non-compulsory education (measured in years). Hence, by age 29, we have three measures for each person's number of non-compulsory education years:

i) Highest completed degree (CD): Normed number of years associated with the highest completed degree

ii) Total credits (TC): Normed number of years associated with all registered credit points

iii) Time spent (TS): Actual number of years registered in non-compulsory education

We then have (by construction) that $TC \geq CD$ and typically (but not always) that $TS \geq TC$.

2.2 Identification of required education in each occupation

To establish the level of required education in each occupation, we use data for all Norwegian employees aged 30-33 in 2003 (the first year of sufficiently complete occupational data). We focus on younger workers in this context as they have been exposed to the same educational system as subsequent cohorts, and also have been hired relatively recently and thus presumably offer an updated picture of the hiring requirements in each occupation. We then define the required education in an occupation as the highest degree needed to account for at least 30% of these newly hired workers. A low-skill occupation is thus an occupation where at least 30% of the young workers do not have any completed degree beyond compulsory education, whereas a medium-low-skill occupation is an occupation where at least 30% of the workers have maximum high-school education. We prefer this definition over the more commonly used definitions based on the mode or the mean education, as it more directly focuses on the level of attainment that seems to be sufficient.[4]

Based on the highest completed degree (CD), we characterize occupations as follows:

i) Low-skill occupations: No non-compulsory education required (105 occupations, comprising 31% of the age 30-33 workers in 2003)

ii) Medium-low-skill occupations: High-school level required (137 different occupations, comprising 36% of the age 30-33 workers in 2003)

iii) Medium-high-skill occupations: Bachelor level required (75 different occupations, comprising 29% of the age 30-33 workers in 2003)

iv) High-skill occupations: Master level required (23 occupations, comprising 4% of the age 30-33 workers in 2003)

The choice of the 30% threshold is a bit arbitrary; hence, it has been guided by a discretionary assessment of plausibility to ensure that the resultant division accords with common sense. In the Appendix Table A1, we show the 10 most common occupations within each category. In the low-skill category, for example, we find occupations such as salespersons (retail), stock clerks, cleaners, waiters, childcare workers (assistants), and truck drivers. In the high-skill category, we find occupations such as medical doctors, college/university teachers, lawyers, architects and engineers.

We have chosen to make the skill-requirement definitions time-invariant. We realize that this may not be valid for all occupations, as technological progress may have changed the requirements. However, based on a closer inspection of the occupations placed in each skill-category, it arguably seems to be appropriate for low-skill and medium-low-skill occupations, and these are the occupations that will play the leading roles in the analysis of overeducation. Had we instead used the 30% cutoff (or the mode) as a time-varying threshold, we could have introduced some rather spurious fluctuations in the

[4] As we return to below, we do, however, present some results based on a mode definition in the appendix.

measured degree of overeducation as occupations close to the threshold could shift from being just above or just below from year to year.

Figure 2 shows the distribution of completed degrees within each occupation category for the 1970-73 birth-cohorts. For comparison, we also show the distribution of attainment for the non-employed and the self-employed. For low-skill occupations, we note that approximately 44% of the workers are without any completed non-compulsory degree. Approximately 41% have completed high-school, 13% have a Bachelor's degree, and 2% have a Master's degree. We thus infer that 56% of the young employees in low-skill occupations have higher educational attainment than what is required. In that sense, they are "overeducated". Based on the same logic, we note that 33% of the employees in medium-low-skill occupations and 15% of the employees in medium-high-skill occupations are overeducated. We emphasize that overeducation as defined here is not necessarily wasted education, in the sense that it does not improve productivity and/or individual wages. That will vary across occupations and workers, and we return to the wage-effects of overeducation later in this paper. Overeducation is in many cases also a temporary state. Approximately 19% of the overeducated age 30-workers in 2003 found a better job within two years.

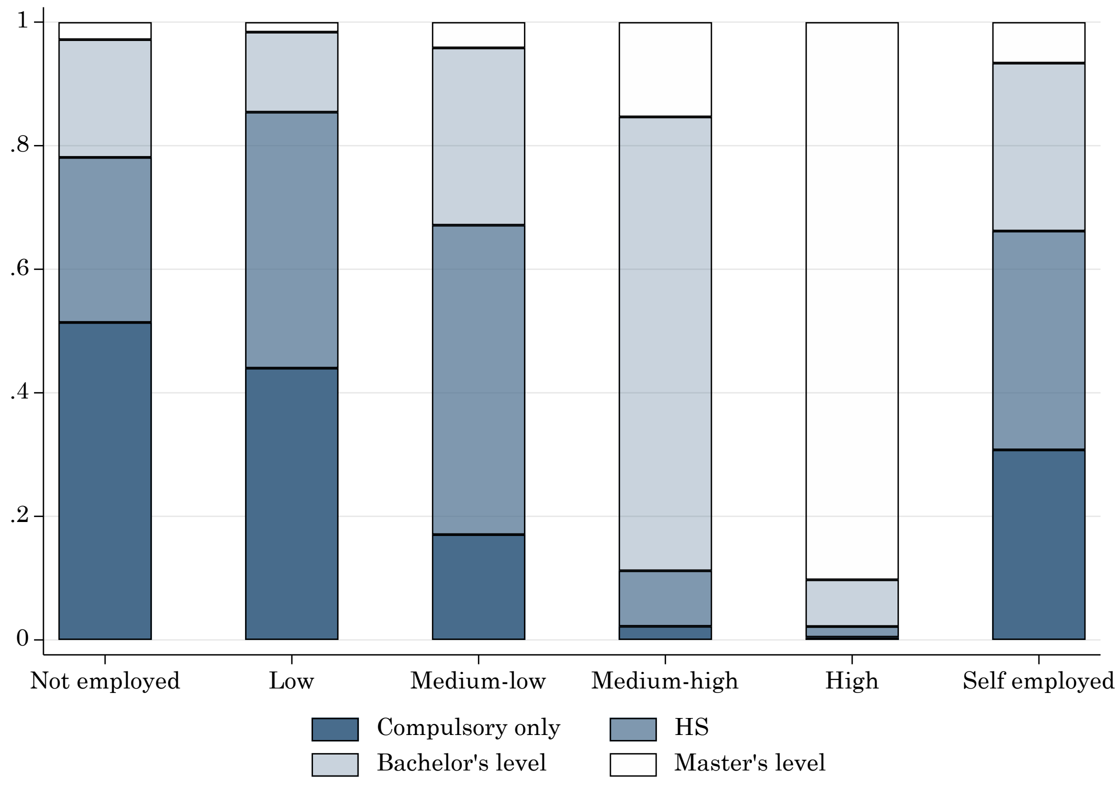

Figure 2. The distribution of completed educational attainment in occupations with different skill requirements
Note: Data based on all residents in Norway born 1970-73. Employment status refers to 2003. Persons with annual earnings below 1 "Basic Amount" (BA) (NOK 118 620 in 2023) are considered non-employed. Persons with earnings above 1 BA, but no registered employer/occupation are considered self-employed. The number of observation is 250,162. 77.3% of the sample are in regular employment, 14.3% are non-employed and 8.4% are self-employed.

2.3 Class background

To establish class background in terms of parental earnings rank, we use data for mother's and father's labor market earnings from their age 47 to age 53, inflated to a common year value based on a national wage index tied to the Basic Amount (BA).[5] This gives us up to 14 annual earnings observations – seven for the father and seven for the mother. We then choose the highest three of the available earnings observations for each parent pair, and use them to rank the parental background of offspring belonging to each birth cohort into 10 equally sized bins (deciles). Markussen and Røed (2020) show that earnings obtained in the mid 50's are most highly correlated with lifetime earnings. When we measure parents a few year younger it is to make the sample as balanced as possible over time, as very young parents are not yet observed in their late fifties at the of our data window. The motivation for using the three best earnings years only is to ensure that the ranks are not excessively influenced by the parents' degree of household specialization or by premature exits from the labor market. For parents born after 1967 we do not have earnings data for the whole age 47-53 interval (as our earnings data ends in 2020), and in these cases we include the required number of earnings observations at lower ages instead.

We use the parental earnings rank to divide offspring into five social/economic classes:

i) The bottom class (first decile in the parental earnings rank distribution),
ii) The lower class (decile 2-3)
iii) The middle class (decile 4-7)
iv) The upper class (decile 8-9)
v) The top class (decile 10)

Although the resultant classes are based on parental earnings, they will obviously reflect everything that is correlated with these earnings, such as the parents' human capital, their social status, peer characteristics, and networks.

2.4 Human capital

For men, we add data on cognitive ability score obtained at enrolment to military service (around age 18/19). These data are not available for women; instead we predict ability scores based on observed scores for brothers or fathers. To ensure comparability, we use predicted (instead of observed) ability scores for both men and women.

For both men and women, we also add data on grade-point averages (GPA) from lower secondary school (obtained at age 15/16). These data are not available for people born before 1986, however; hence we can only use these data for more recent cohorts. GPA is a composite of grades obtained in all subjects at the final year of compulsory school, some graded by the teacher and some by external examiners.

In some parts of the paper, we use family fixed effects as a proxies for socially and genetically inherited human capital characteristics.

3 Trends in educational attainment and occupational structure

In this section, we describe trends in educational attainment and occupational structure. The description is based on the complete population born from 1973 through 1992, provided that at least one parent can be identified in administrative registers and that the persons in question are still alive and residents in Norway at age 30. Employment and occupation is recorded at age 30, whereas educational attainment and educational activities are registered up to age 29.

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[5] The Basic Amount is a part of the Norwegian Pension system, and it is adjusted each year approximately in line with the average wage growth.

Figure 3 shows how the distribution of highest completed educational degree has changed over the 1973-92 birth cohorts, together with the distribution of skill-requirements for the jobs held by employees in the same cohorts. Focusing first on the distribution of attainment, we note that the fractions with only compulsory or high-school education have declined somewhat, particularly among women, and particularly between the 1973 and the 1979 cohorts. The fractions with Bachelor's or Master' degrees have increased, again particularly among women. At the end of our data period (the 1992-cohort), as much as 65% of the females have a Bachelor's or a Master's degree, as opposed to 45% of the males.

Changes in the occupational composition have also raised the levels of required education, though not to the same extent. In particular, considering jobs held by workers of age 30, the fraction without any educational requirements at all has dropped, from around 30% for the 1973-cohort (in 2003) to 23% for the 1992-cohort (in 2022). Whereas the fractions of jobs with either high-school or master's requirements have remained stable, jobs requiring a Bachelor's degree have become much more widespread.[6]

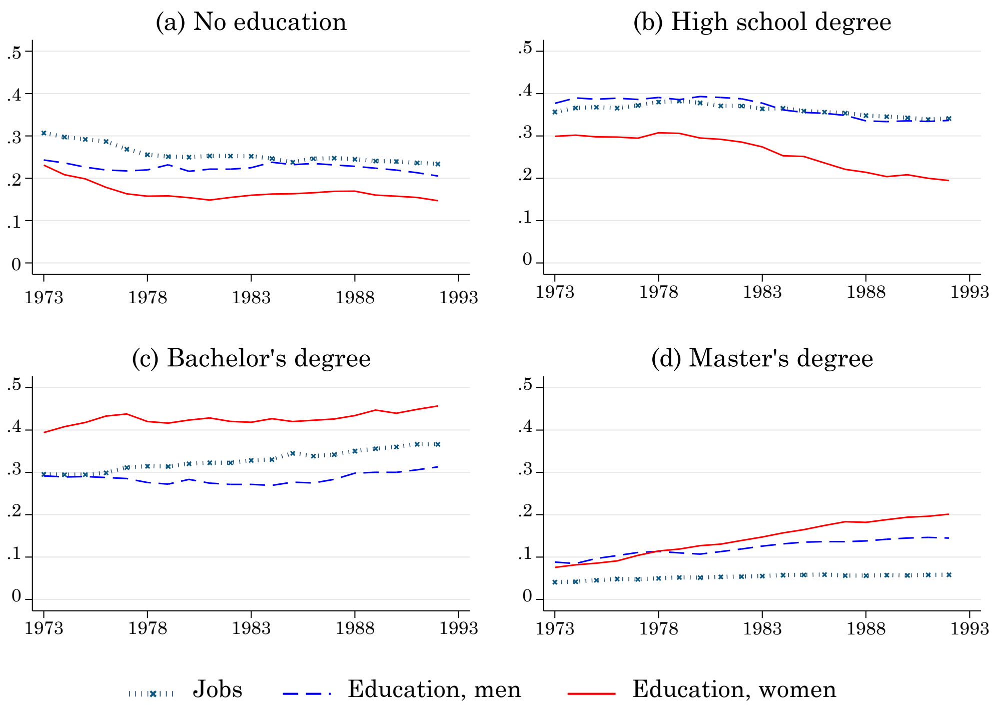

Figure 3. Highest completed degree and the distribution of educational job requirements by age 30.
Note: Job requirements are measured for all employees in our data at age 30, and the "Jobs" lines show the fraction of jobs requiring no particular education (panel a), high-school degree (panel b), Bachelor's degree (panel c), and Master's degree (panel d). The "Education" lines show the fractions of the complete birth cohorts (including non-employed and self-employed) holding the corresponding attainment levels (highest completed degree).

It seems clear that the rise in attainment is larger than the rise in educational requirements that can be attributed to changes in the composition of occupations. This point is further illustrated in Figure 4,

[6] In the Appendix Figure A1, we show how occupational requirements have changed when we use the modal education to define occupational requirements. Based on this criterion, there are much fewer low-skill jobs and more medium-high and high skill jobs, and also smaller changes over time.

where we show how the mean (normed) completed-degree-years have changed among employees together with the changes that can be explained entirely by shifts in the occupational structure (i.e., with the composition of education within each occupation exactly as for the 1973-cohort). The rise in attainment levels has been much larger than predicted from changes in the occupational composition only. Hence, as illustrated by the grey areas in the two panels, educational attainment has increased considerably also within narrowly defined occupations.

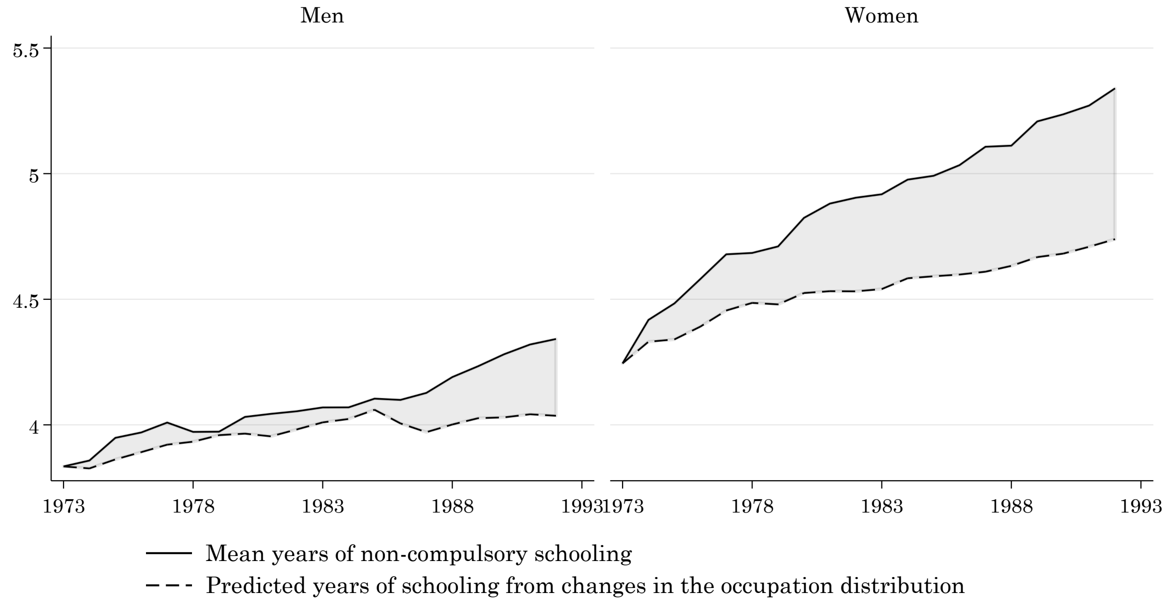

Figure 4. Mean years of highest completed degree among persons employed at age 30 and predictions based on changes in occupational distribution only. By birth year.

Note: The solid lines describe the average number of normed non-compulsory education years (completed degrees) for all employees aged 30 by birth year. The dashed lines show what these numbers would have looked like if the distribution of educations within each occupation had been the same as it was for the 1973-cohort.

Figure 5 shows trends in educational attainment for the complete birth cohort, measured in terms of normed years and in terms of time spent up to age 29. All the metrics display an upwards trend. At the end of the period, the average young man (woman) has reached a degree normally requiring 4.0 (4.9) non-compulsory years of education, and in addition completed approximately 0.6 (0.8) years of education that do not contribute to a higher degree; see panels A and B. To achieve this education he (she) has on average spent 5.6 (6.2) years. Looking at the last cohort for which all three measures are available (the 1990-cohort), it is notable that the difference between normed and actual time spent for all credits achieved (TS-TC) is considerably larger for men than for women (1.1 versus 0.7).

The bottom panels of Figure 5 show trends in educational attainment by class background. There is a remarkable social gradient in educational achievements as well as in time spent in education. And with rising attainment, the social gradient has also become steeper. It is also notable that the difference between time spent and highest completed degree declines with class background. And whereas time spent and highest degree have exhibited parallel positive trends for most individuals, there is a notable exception for the bottom class where we see a slightly larger increase in time spent than in highest degree.

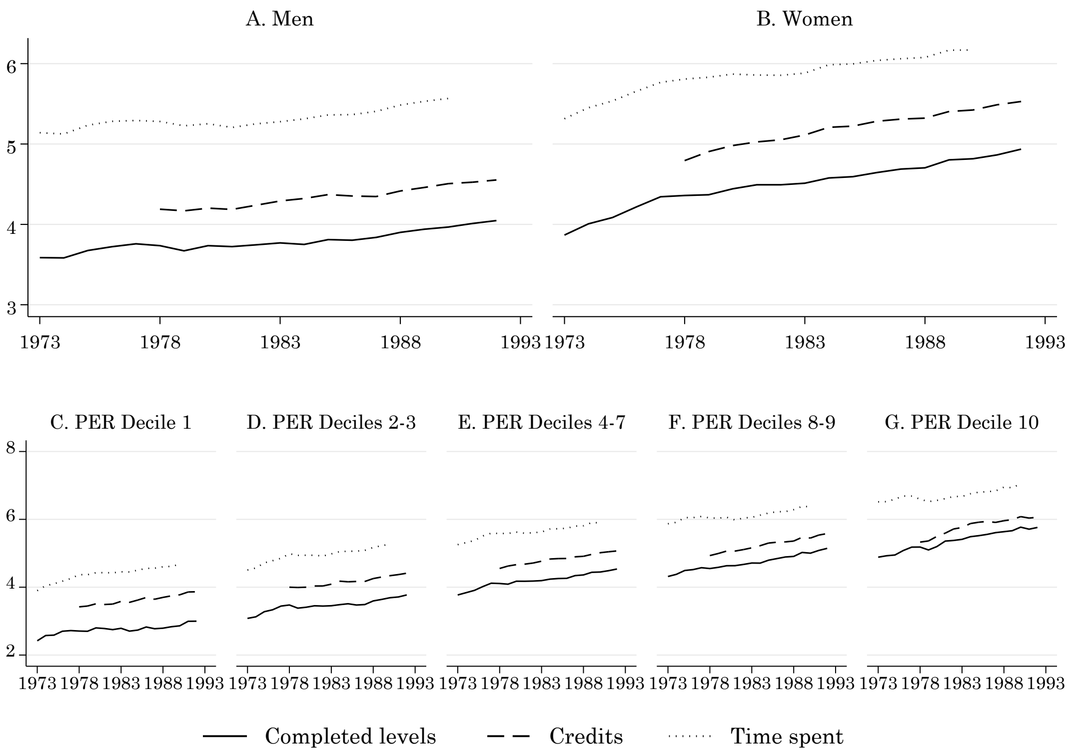

Figure 5. Years of education by birth year (measured at age 29). By gender and parental earnings rank (PER).
Note: See Section 2.1 for the definitions of education and Section 2.3 for the identification of parental earnings rank.

4 Trends in overeducation

In this section, we examine the incidence and the degree of overeducation among employees, by birth cohort. Overeducation is in this context interpreted as all education beyond what we have identified as required for each occupation.

Figure 6 displays the incidence by age 30 of two measures of overeducation, based on highest completed degree (CD) and total credits (TC), respectively. Using CD, the fraction of overeducated men has increased by approximately 5 percentage points, from 36 to 41%.[7] The fraction of overeducated women has increased by 8 percentage points, from 32 to 40%. Taking additional credits into account, the levels of overeducation are much higher, and for women they have also risen considerably more. There is a remarkable social gradient in the incidence of overeducation, and it has become steeper over time. Whereas the incidence of overeducation has remained relatively stable at 30-32% in the bottom parental earnings class, it has increased from 40 to 50% in the top class.

[7] These numbers are a bit higher than self-reported instances of overqualification. According to a survey made by FINN (2019), 31% of Norwegian age 18-29 workers and 24% of age 30-39 workers consider themselves as overqualified for their current job.

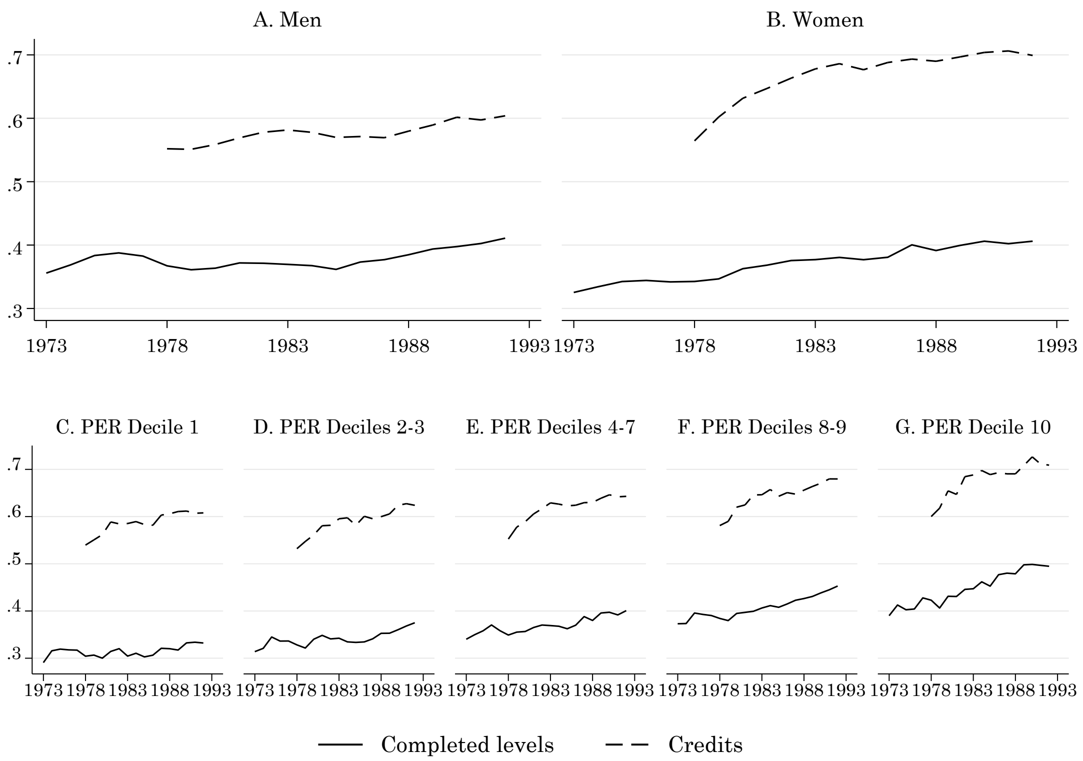

Figure 6. Fraction overeducated at age 30 by birth year. By gender and parental earnings rank.
Note: The data cover people employed at age 30. See Section 2.1 for the definitions of education, Section 2.2 for the definition of required education, and Section 2.3 for the identification of parental earnings rank.

Similar pictures emerge when we look at the *degree* of overeducation, measured as the average difference between attained and required education years; see Figure 7. A possible interpretation of these patterns is that educational ability and family encouragement/support are positively correlated with class background, such that it is less costly for offspring from upper classes to obtain higher education. In response to the rising private returns to educational attainment, this comparative advantage has become more important. However, as educational attainment has risen faster than educational requirements, jobs that do not require higher education have to an increasing extent been filled by overeducated persons from the middle and upper classes who has out-conquered qualified, but less educated, persons from the lower classes.

Appendix Figures A2 and A3 show versions of Figure 6 and 7 where we have used the modal education in each occupation to define occupational requirements. The fractions as well as the level of overeducation then become considerably smaller, whereas the trends and class structure remain more or less the same.

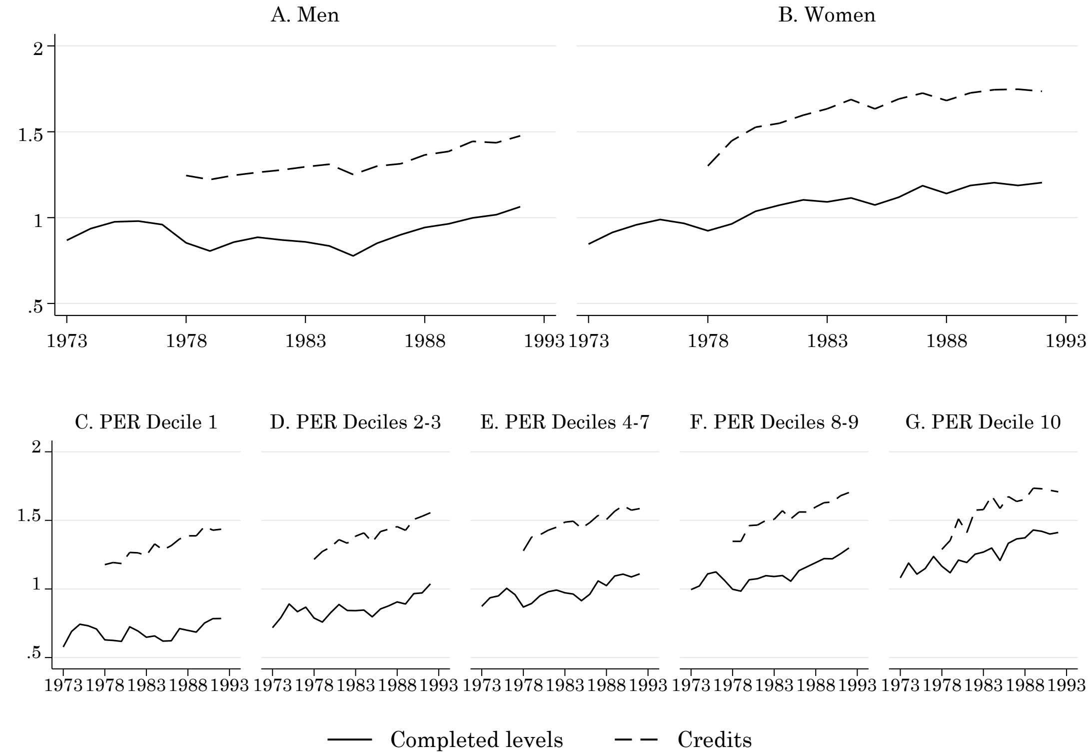

Figure 7. Average years of overeducation (degree/credits minus required) among employees at age 30 by birth year. By gender and parental earnings rank.

Note: The data cover people employed at age 30. See Section 2.1 for the definitions of education, Section 2.2 for the definition of required education, and Section 2.3 for the identification of parental earnings rank.

5 The individual educational earnings premium

In this section, we evaluate the earnings premium associated with alternative definitions of educational attainment. In order to include as recent cohorts as possible in our analysis, we measure earnings and wage outcomes as early as age 30 or 32, which most likely is a bit too early in order to properly assess the effects on lifetime (permanent) income or on the internal rate of return to educational investments; see, e.g., Bhuller et al. (2017). A primary purpose of our analysis is to disentangle the educational earnings premium into its three separate channels of employment propensity, choice of occupation, and earnings within occupation. In addition, we aim at assessing the influence of the alternative measures of education, such as the highest completed versus the time spent, and, conditional on occupation, the required education versus overeducation.

5.1 Trends in the educational earnings premium and its sources

We first evaluate the earnings premium in terms of overall annual earnings obtained at age 30. To identify the three separate channels of employment propensity, choice of occupation, and earnings level within occupation, we estimate three linear regressions, with educational attainment (or time spent in education) as the key explanatory variable. In addition, we include indicator variables for gender and birth-year. To mitigate selection problems, we also include family-fixed effects.

As before, we define employment as having annual earnings above 1 “Basic Amount” (BA). Let $\bar{y}^e$ be the average annual earnings level among all employees, let $\bar{y}^n$ be the average earnings of the non-employed (close to zero), and let $\bar{y}_i$ be a dichotomous variable equal to $\bar{y}^e$ for all employees and $\bar{y}^n$

otherwise. Furthermore, let $\overline{y}_{io}$ be the average earnings level in individual *i's* occupation *o* ($\overline{y}^n$ for the non-employed), and let y_i be individual *i's* own earnings level (zero or close to zero for the non-employed). The three regressions can then be expressed as follows:

$$\overline{y}_i = \alpha_1 + \beta_{1HS} HS_i + \beta_{1BAC} BAC_i + \beta_{1MAS} MAS_i + Controls + \varepsilon_{1i} \ , \quad (1)$$

$$\overline{y}_{io} - \overline{y}_i = \alpha_2 + \beta_{2HS} HS_i + \beta_{2BAC} BAC_i + \beta_{2MAS} MAS_i + Controls + \varepsilon_{2i} \ , \quad (2)$$

$$y_i - \overline{y}_{io} = \alpha_3 + \beta_{3HS} HS_i + \beta_{3BAC} BAC_i + \beta_{3MAS} MAS_i + Controls + \varepsilon_{3i} \ , \quad (3)$$

with HS_i =1 if attainment is at least at the high school level, BAC_i =1 if attainment is at least at the Bachlor's level, and MAS_i =1 if attainment is at least at the Master's level. The reference category is less than completed high school. Equation (1) is the employment regression (with a scaled dichotomous variable as the outcome), Equation (2) identifies the earnings premium derived from the chosen occupation, and Equation (3) identifies the within-occupation contribution.

It is clear that a regression of y_i directly on educational attainment will give coefficients that adds up the coefficients from regressions (1), (2) and (3); hence, for example, $\beta_{1HS} + \beta_{2HS} + \beta_{3HS}$ is the estimated total effect on age-30 earnings of having a high-school degree as the highest attainment. As we aim for a linear decomposition in this analysis, which also includes a large number of zero-earnings, we measure earnings in levels (1000 NOK inflated to 2022-value with the BA wage growth index) rather than in logs.[8] We return to the more standard log-specification in the next subsections, where we examine hourly wages conditional on employment.

Based on point estimates from the three regressions described above, Figure 8 presents a decomposition of the earnings premium for the three categories of non-compulsory education.[9] Our estimates suggest that the overall premium related to high-school education has increased from NOK 120,000 to NOK 180,000 (i.e., by approximately 50%) over the past 15 years. This increase is fully accounted for by a stronger association with the probability of being employed. Adding a Bachelor's degree raises the premium further by NOK 70-80,000, with most of the extra earnings coming from a better paid occupation. Also adding a Master's degree raises earnings still further by NOK 140-150,000, with contributions from both a better paid occupation and higher within-occupation pay. However, the overall earnings premium related to Bachelor's and Master's degrees have remained stable over the period covered here.[10]

[8] To avoid excess outlier-influence, we have winsorized the outcomes at zero and at 20 BAs, the latter number corresponding to NOK 2.37 million in 2023.

[9] For expository reasons, we disregard (the small) statistical parameter uncertainty here. We present estimates with standard errors for selected cohorts below.

[10] In Appendix Figure A2, we present the results shown in Figure 8 for each of the five PER classes separately, but then for all cohorts taken together. The results indicate that the structure of earnings premiums are similar across classes, yet with a slight U-shape, such that the returns are largest at the bottom and the top of the class distribution.

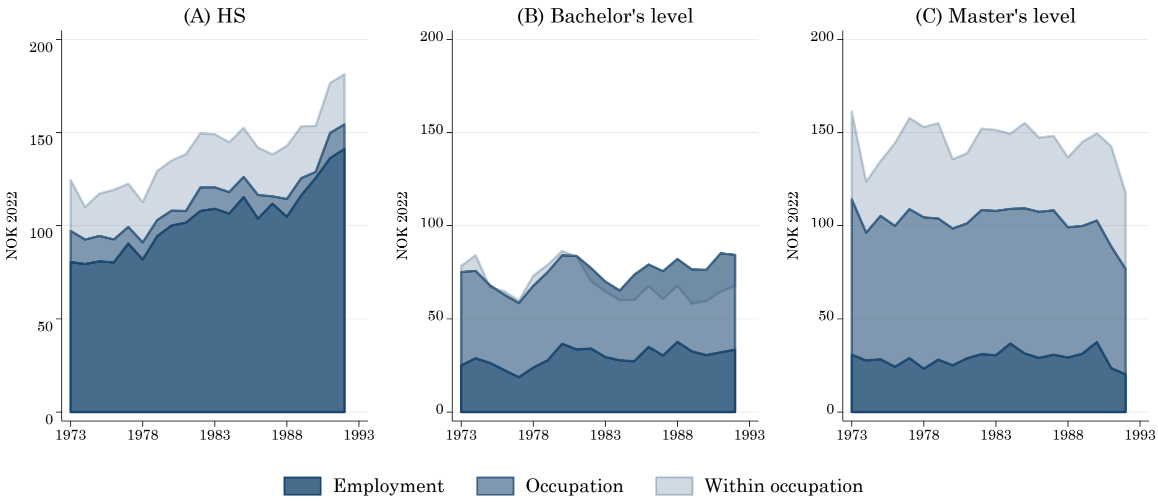

Figure 8. The earnings premium at age 30 associated with completed degrees of education. By birth year.
Note: Each panel reports the estimated added premium in excess of the premium derived from lower degrees. For example, the overall estimated premium for a Master's degree (compared to no non-compulsory education) is the sum of the premiums in panels A, B, and C. Average earnings (measured in 2022-value) in our data are NOK 507,730 (unconditional on employment). All regressions also include indicator variables for sex and birth-year. Total number of observations is 1,076,411, but due to the use of family fixed effects only 779,828 observations (72%) contribute to identification of the parameters. R-squared for the total regression (using total earnings directly as the explanatory variable) is 0.596.

In Figure 9, panel A, we show estimates from a model where we have converted the highest completed degree into normed years of education, such that the estimates can be interpreted as extra earnings gained per year normally required to reach the highest completed degree. In Equations (1)-(3) we have thus substituted a scalar (normed years of highest completed degree) for the three categorical variables, assuming a linear relationship between years of education and outcomes. Overall, our estimates indicate that the premium associated with each extra (successfully completed) education year has increased from around NOK 35,000 for cohorts born in the mid-seventies to 40,000 for the most recent cohorts (corresponding to 7-8% of average earnings in our data). Similar estimates are obtained when we instead use the years normally required to obtain all educational credit points (panel B).

However to assess the returns to education from an individual perspective, the economic rewards need to be evaluated relative to the time actually invested in it and without conditioning on the result. Using time spent in education as the key explanatory variable instead of normed years for the highest completed degree reduces the overall premium estimate by approximately 40%, and the within-occupation premium disappears or becomes negative.

It is notable that irrespective of the way we measure educational attainment, the estimated *rise* in its premium is fully accounted for by its stronger association with employment propensity. Using the words of Caplan (2018, p. 108), we could perhaps say that “the amount of education you need to *get* a job really has risen more than the amount of education you need to *do* a job.”

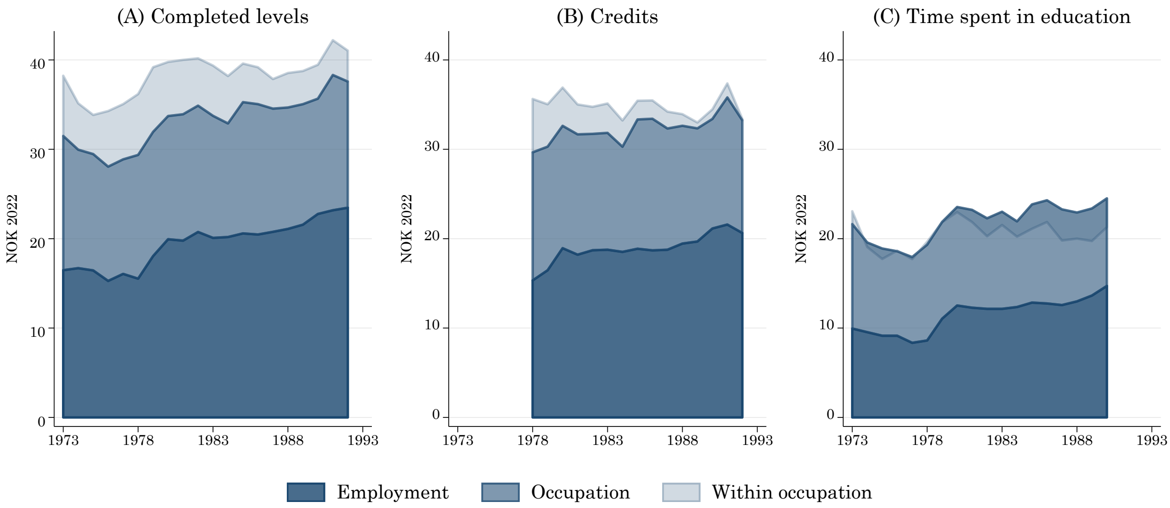

Figure 9. The earnings premium at age 30 associated with years of non-compulsory education. By definition of years of education. By birth year

Note: All regressions also include indicator variables for sex and birth-year. Total number of observations is 1,076,411, but due to the use of family fixed effects only 779,828 observations (72%) contribute to identification of the parameters.

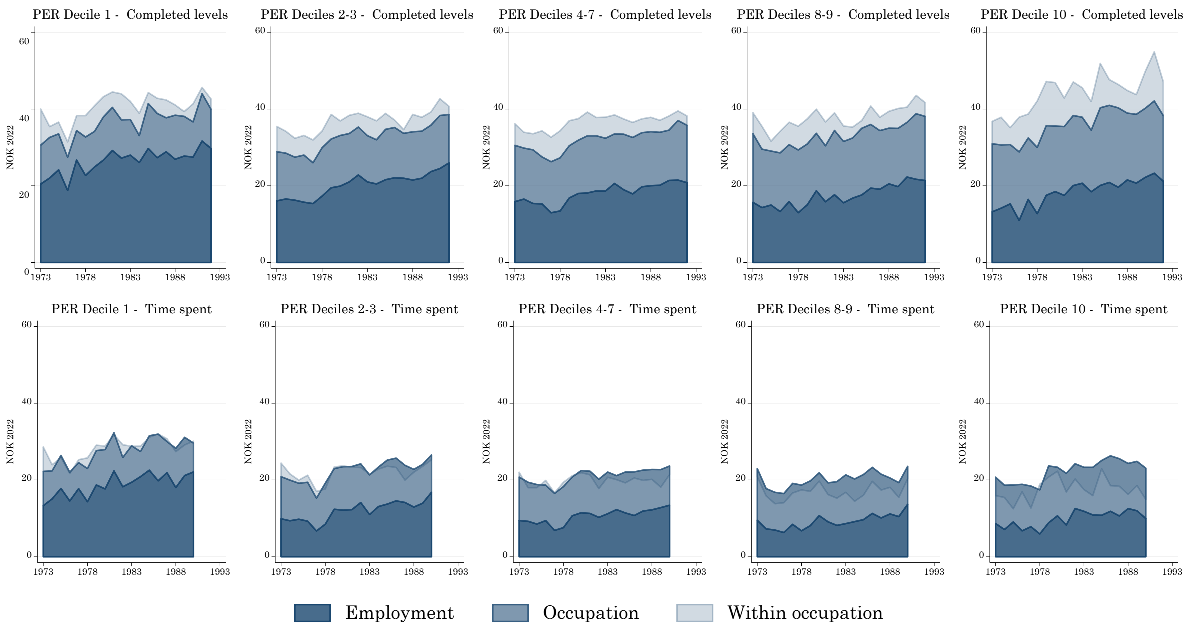

Figure 10. The earnings premium at age 30 associated with years of non-compulsory education. By definition of years of education. By class background and birth year

Note: All regressions also include indicator variables for sex and birth-year. Total number of observations is 1,076,411, but due to the use of family fixed effects only 779,828 observations (72%) contribute to identification of the parameters.

In Figure 10, we report returns-estimates for completed degrees and time spent, by class background. The total earnings premiums for completed levels (the top five panels) are similar across the class distribution, but whereas the employment margin accounts for most of the returns for bottom class offspring, the occupation and within-occupation margins are more important at the top. The overall premiums derived from time spent in education (the bottom five panels) are largest for offspring with a disadvantaged family background, despite the fact that the difference between normed years and time spent is largest for the bottom class (see Figure 5). This may reflect that selection into education based on expected returns is stronger for the lower than for the upper classes, as upper class offspring more often are expected by their parents to take education regardless of their talents, and thus spend more time in education without obtaining a corresponding degree. This is to some extent confirmed by the fact that the correlation between completed degree and time spent is particularly low for the top class (correlation coefficient equal to 0.746, compared to 0.788 for the middle class and 0.765 for the bottom class). The within-occupation returns to time spent also seem to be more negative the higher is the class background.

To assess the degree of statistical uncertainty as well as the estimates' sensitivity with respect to the model specification and the use of control variables, we zoom in on three cohorts for which we have access to rather unique data on (predicted) cognitive ability (IQ) as well as grade point average (GPA) from junior high school. Table 1 presents the key estimation results for two alternative models; one with controls for observed human capital characteristics, represented by interaction terms for the within-cohort deciles in the distributions of GPA, predicted IQ, and parental earnings rank (10^3=1000 combinations) plus dummy variables for the municipality of residence by age 16 (435 categories); and another with family fixed effects plus indicators for the decile position in the cohort-specific GPA distribution (the other indicators are in practice absorbed by the family fixed effects). In the latter model, we can only use siblings that are born within the short time interval 1986-88; hence we lose most (86%) of the observations.

The table reports results for four alternative specifications of the education variables; i.e., as degree category completed, as normed years for highest degree, as normed years for total credits, and as years actually spent. The estimated returns to education are typically smallest in the model combining family-fixed effects with a flexible specification of GPA from junior high school, although the differences between this model and the model with human capital controls (and with seven times as many observations) are small. The following conclusions appear robust:

i) High-school education primarily affects earnings through the margins of employment and within-occupation pay. The effect on earnings through occupational choice is minimal.
ii) Bachelor's level education affects earnings primarily through occupational choice, whereas Master's level education affect earnings through both occupational choice and within-occupation pay.
iii) In the models where attainment is measured in years, the returns drop considerably when the years are defined in terms of time actually spent (TS) instead of normed years for the highest completed degree (CD).

The latter difference is sometimes interpreted as the so-called sheepskin effect; i.e., the part of the education premium that stems from graduation and, hence, can be attributed to signaling; see, e.g., Jaeger and Page (1996) and Caplan (2018). Adding up the three estimated effects operating through employment, occupational choice and within-occupation earnings, we obtain a premium of NOK 38-40,000 (depending on model) for each education year that leads to a diploma, but only 18-19,000 for each year actually spent in education. According to these estimates, up to 50-55% of the earnings premium can be attributed to the sheepskin effect. The existence of a sheepskin effect in relation to high-school diplomas in Norway has also been confirmed by Andresen and Løkken (2023), who study the outcomes of high-stakes exams in the Norwegian High School and show that failing due to randomly being drawn to a written high-fail-probability exam rather than an oral low-fail-probability exam has considerable consequences for the future career of academically marginal students. Failing the exam translates into lower wage earnings as adults and a higher probability of becoming self-employed.

Table 1. The educational earnings premium decomposed

	Employment (Eq. (1))		Occupation (Eq. (2))		Within-occupation (Eq. (3))	
	HC controls	Fam. fixed eff.	HC controls	Fam. fixed eff.	HC controls	Fam. fixed eff.
A. Education categories						
High school (HS)	96.741	76.605	8.749	10.124	51.598	45.103
	(1.238)	(4.696)	(0.956)	(3.712)	(1.718)	(6.862)
+ Bachelor's degree	13.550	22.615	52.896	51.495	-1.317	1.253
	(1.096)	(4.116)	(0.846)	(3.254)	(1.521)	(6.014)
+ Master's degree	23.624	27.716	85.994	79.740	28.977	20.818
	(1.283)	(4.799)	(0.990)	(3.793)	(1.780)	(7.012)
R-squared	0.260	0.672	0.232	0.650	0.040	0.541
B. Normed years highest degree						
Years (CD)	15.738	15.073	16.102	15.454	8.256	7.254
	(0.199)	(0.784)	(0.155)	(0.626)	(0.275)	(1.144)
R-squared	0.250	0.670	0.209	0.642	0.037	0.540
C. Normed years total credits						
Years (TC)	13.275	13.824	15.106	14.424	3.856	4.201
	(0.221)	(0.862)	(0.173)	(0.694)	(0.304)	(1.257)
R-squared	0.238	0.666	0.194	0.637	0.032	0.539
D Time spent						
Years (TS)	6.092	6.312	11.109	10.843	0.930	1.372
	(0.206)	(0.817)	(0.161)	(0.652)	(0.281)	(1.178)
R-squared	0.225	0.661	0.180	0.632	0.032	0.539
E. Model properties						
Gender- and cohort fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes
GPA-by-IQ-by-PER fixed eff.	Yes		Yes		Yes	
GPA rank fixed effects		Yes		Yes		Yes
Family-fixed eff.		Yes		Yes		Yes
Municipality-fixed effect	Yes		Yes		Yes	
N	159989	23088	159989	23088	159989	23088

Note: The dependent variable is annual earnings in the year persons become 30 years. All estimates are measured in 1000 NOK (inflated to 2022 value). Standard errors are reported in parentheses. GPA-by-IQ-by-PER fixed effects are represented by 1,000 dummy variables obtained by interacting decile indicators for each of the distributions of GPA, IQ and parental earnings rank. GPA rank fixed effects are represented by 10 dummy variables, one for each decile. All regressions also include indicator variables for sex and birth-year.

In Figure 11, we present estimates for the effects of normed years for completed degrees (CD) and for time spent (TS) by class background. Models with and without family-fixed effects give similar results. Whereas the returns to CD are similar across the class distribution, perhaps with a modest U-shape, the estimated returns to TS declines monotonically with class background. Hence the difference between the two rises with class background, suggesting that it not only captures a common sheepskin effects, but also mirrors unobserved differences in efforts and talents among those enrolled in education.

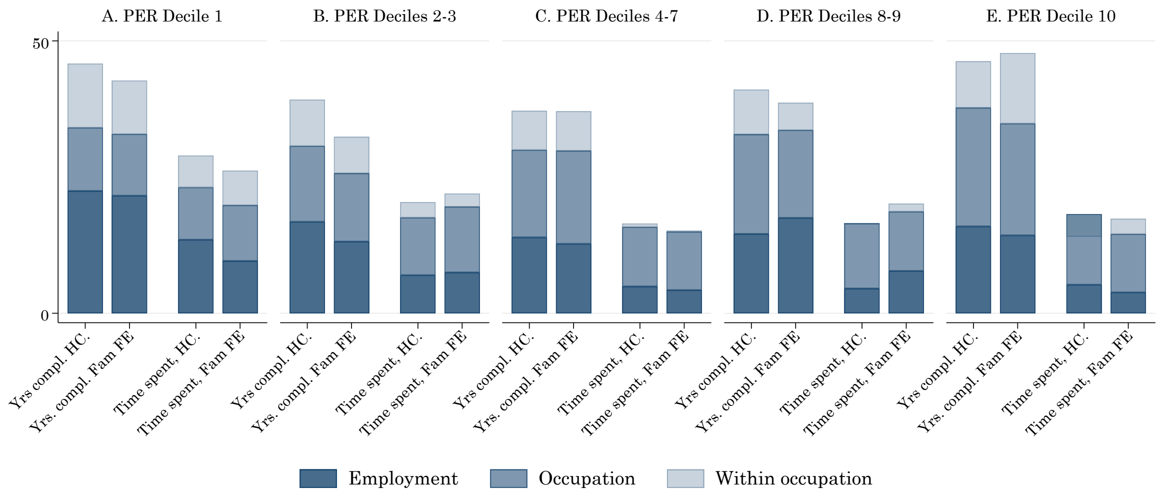

Figure 11. The educational earnings premium by class background
Note: The figure reports point estimates. Years completed refers to the highest completed degree (CD). The two models (HC and Fam FE) refers to the models used in Table 1. See also note to Table 1.

5.2 The returns to education conditional on employment

We now turn to the identification of educational wage premiums conditional on employment. For the 1986-88 cohorts, we have access to data on hourly wages as late as at age 32; hence we use the log hourly wage in the main job held at age 32 as the outcome of interest. We deviate from the standard Mincer-model in that we do not control for experience (or tenure). The motivation for this is that by age 32 – when we measure the wage level – it is natural to think of experience as largely determined by time spent in education. The alternative to obtaining a longer education will typically be to start working earlier. If conditioning on experience, one arguably estimates the returns to education *as if* it did not cost anything in terms of a lower wage due to forgone work experience. With categorical education, the regression becomes

$$\log(w_i) = \delta + \gamma_{HS} HS_i + \gamma_{BAC} BAC_i + \gamma_{MAS} MAS_i + Controls + \xi_i \tag{4}$$

With education measured in terms of years instead, we replace the three indicator variables (HS_i, BAC_i, MAS_i) with years of education $(YOE_i = CD, TC, \text{ or } TS)$. The results are shown in Table 2. With the standard specification using normed years of highest degree (CD) as the explanatory variable (Panel B), our estimates indicate that an extra year of successful education raises the hourly wage at age 32 by 3.2%, out of which 1.8% is identified as a within-occupation component. Comparing these estimates with those obtained with the categorical model (panel A), it seems that the linear-in-years model fits the data quite well (taking into account the number of years associated with each category).

The estimated returns drop considerably when we measure education by total credits obtained (panel C) or by time actually spent (panel D). In the latter case, the models with either human capital controls or family-fixed effects indicate a wage premium per year spent in education as low as 1.6-1.8%, with only 0.5-0.7% identified as a within-occupation contribution. If the difference in returns to diploma-confirmed years and years actually spent is interpreted as a sheepskin effect, this result suggests that signaling may account for roughly half of the educational wage premium.

Table 2. The educational wage premium conditional on employment

	Total returns (Eq. (4))		Within occupation (Eq. (4))	
	HC controls	Fam. fixed eff.	HC controls	Fam. fixed eff.
A. Education categories				
High school (HS)	0.087	0.099	0.058	0.071
	(0.003)	(0.013)	(0.003)	(0.012)
+ Bachelor's degree	0.070	0.062	0.032	0.023
	(0.002)	(0.010)	(0.003)	(0.011)
+ Master's degree	0.126	0.124	0.078	0.069
	(0.003)	(0.011)	(0.003)	(0.012)
R-squared	0.186	0.622	0.336	0.699
B. Normed years highest degree				
Years (CD)	0.032	0.032	0.018	0.018
	(0.000)	(0.002)	(0.001)	(0.002)
R-squared	0.182	0.620	0.334	0.698
C. Normed years total credits				
Years (TC)	0.022	0.021	0.012	0.011
	(0.000)	(0.002)	(0.001)	(0.002)
R-squared	0.161	0.612	0.329	0.696
D. Time spent				
Years (TS)	0.016	0.018	0.005	0.007
	(0.000)	(0.002)	(0.000)	(0.002)
R-squared	0.156	0.611	0.327	0.695
E. Model properties				
Gender- and cohort fixed eff.	Yes	Yes	Yes	Yes
GPA-by-IQ-by-PER fixed effects	Yes		Yes	
GPA rank		Yes		Yes
Family-fixed effects		Yes		Yes
Occupation-fixed effects			Yes	Yes
N	112635	13728	112632	13681

Note: The dependent variable is log(hourly wage) in the main job held at age 32. Standard errors are reported in parentheses. GPA-by-IQ-by-PER fixed effects are represented by 1,000 dummy variables obtained by interacting decile indicators for each of the distributions of GPA, IQ and parental earnings rank. GPA rank fixed effects are represented by 10 dummy variables, one for each decile. All regressions also include indicator variables for sex and birth-year.

In Figure 12, we present estimates for the effects of normed completed-degree-years and time spent by class background, with 95% confidence intervals. Also for the conditional wage effects, we find that the influence of normed completed-degree-years exhibit a weakly U-shaped pattern, with largest effects at the bottom and the top of the class distribution. And again, the effects of time spent declines monotonically with class background. These results hold both for the total returns and the within-occupation returns.

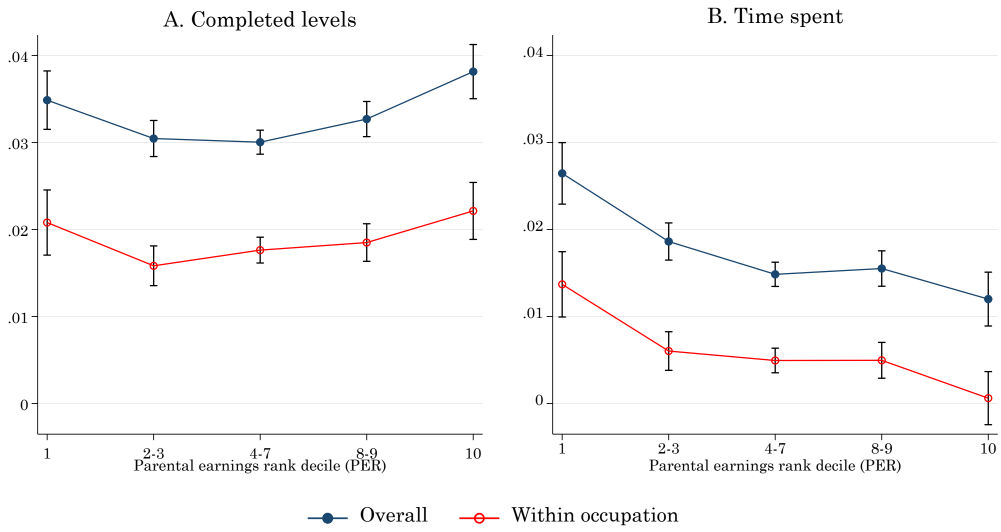

Figure 12. The educational wage premium conditional on employment. By class background.
Note: The estimates are based on the model with human capital controls; see Table 2. The figure reports point estimates with 95% confidence intervals. Completed levels refer to the highest completed degree (CD).

5.3 The returns to overeducation and undereducation

We now turn to a more direct analysis of the returns to required education as opposed to overeducation and undereducation. The analysis is built on what is sometimes referred to as "Duncan-Hoffman regressions" (Duncan and Hoffman, 1981). Let RE_i be a measure of required education in individual i's occupation, either specified as a category (no requirements, high-school, bachelor's or master's) or as normed years of education. Let OE_i be a measure of overeducation (max(0, obtained minus required degree)) and let UE_i be a measure of undereducation (max(0, required minus obtained degree)). Furthermore, let EC_i be any extra credits beyond the highest obtained degree (also measured in years). Our regression is then specified as follows:

$$\log(w_i) = \phi + \lambda_{RE} RE_i + \lambda_{OE} OE_i + \lambda_{UE} UE_i + \lambda_{EC} EC_i + Controls + \zeta_i \quad (5)$$

The results are shown in Table 3; in panel A with required degree specified as categorical and in panel B with required degree specified as years of education. Focusing on the latter model, we note that an extra education year exploited in an occupation that actually requires this year is associated with a higher hourly wage close to 5%. A year of overeducation gives an extra bonus of 3%, whereas a year of undereducation cuts the wage by 1.8%. Hence, educational attainment seems to pay off in terms of individual wage, even when it deviates from the required education in the chosen occupation. This does not seem to be the case for extra credits, however, which actually affect the wage negatively in our regression. We suspect that the latter result either reflects unobserved sorting or that the extra credits have come at the cost of less work experience.

Table 3. The educational wage premium from required education, overeducation, and undereducation

	HC controls (Eq. (5))	Fam. fixed eff. (Eq. (5))
A. Required education category		
High school (HS)	0.160	0.178
	(0.003)	(0.011)
+ Bachelor's degree	0.085	0.101
	(0.002)	(0.010)
+ Master's degree	0.136	0.168
	(0.004)	(0.016)
Overeducation (years)	0.028	0.028
	(0.001)	(0.003)
Undereducation (years)	-0.019	-0.018
	(0.001)	(0.004)
Extra credits (years)	-0.009	-0.002
	(0.001)	(0.003)
R-squared	0.205	0.953
B. Required years of education		
Years required	0.041	0.047
	(0.001)	(0.002)
Overeducation (years)	0.030	0.030
	(0.001)	(0.003)
Undereducation (years)	-0.018	-0.018
	(0.001)	(0.004)
Extra credits (years)	-0.013	-0.005
	(0.001)	(0.003)
R-squared	0.202	0.953
C. Model properties		
GPA-by-IQ-by-PER fixed effects	Yes	
GPA rank		Yes
Family-fixed effects		Yes
No. observations	112635	13728

Note: The dependent variable is log(hourly wage) in the main job held at age 32. Standard errors are reported in parentheses. GPA-by-IQ-by-PER fixed effects are represented by 1,000 dummy variables obtained by interacting decile indicators for each of the distributions of GPA, IQ and parental earnings rank. GPA rank fixed effects are represented by 10 dummy variables, one for each decile. All regressions also include indicator variables for sex and birth-year.

We finally look at the educational wage premiums by type of job. For occupations belonging to skill group S, we estimate

$$\log(w_i) = \pi^S + \theta^S_{HG} CD_i + \theta^S_{TC}(TC_i - CD_i) + Controls + \xi^S_i, \quad (6)$$
$$S = \text{low-skill, medium-low-skill, medium-high-skill, high-skill}$$

such that we allow for a separate effect of credits obtained beyond the highest degree. The results are shown in Table 4. Degrees give higher wages regardless of the occupation in question. Even in low-skill occupations, where any degree is overeducation by construction, an extra education year entails a 1.1-

1.5% wage increase. It is notable, however, that additional credits are not rewarded at all, and in high-skill occupations even contribute negatively (most likely because the extra credits have been obtain at the cost of shorter work experience).

Table 4. The educational wage premium by type of occupation

	Low-skill jobs		Medium-low-skill jobs		Medium-high-skill jobs		High-skill jobs	
	HC controls (Eq. (6))	HC controls + occup. FE (Eq. (6))	HC controls (Eq. (6))	HC controls + occup. FE (Eq. (6))	HC controls (Eq. (6))	HC controls + occup. FE (Eq. (6))	HC controls (Eq. (6))	HC controls + occup. FE (Eq. (6))
A. Education								
Normed years highest degree (CD)	0.015	0.011	0.026	0.018	0.029	0.024	0.032	0.034
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.004)
Additional credits (TC-CD)	-0.000	-0.003	-0.002	-0.007	-0.001	-0.004	-0.015	-0.018
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)
R-squared	0.141	0.177	0.264	0.292	0.361	0.384	0.409	0.473
B. Model properties								
Gender- and cohort fixed eff.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GPA-by-IQ-by-PER fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation-fixed effects		Yes		Yes		Yes		Yes
No. observations	26707	26698	39652	39652	39886	39882	6387	6204

Note: The dependent variable is log(hourly wage) in the main job held at age 32. Standard errors are reported in parentheses. GPA-by-IQ-by-PER fixed effects are represented by 1,000 dummy variables obtained by interacting decile indicators for each of the distributions of GPA, IQ and parental earnings rank. All regressions also include indicator variables for sex and birth-year.

6 Concluding remarks

Based on administrative data from Norway, we have examined the patterns of education, overeducation, and earnings for cohorts born between 1973 and 1992. We have defined overeducation as attainment in excess of the lowest degree needed to account for at least 30% of newly hired employees in the occupation. Our main findings can be summarized as follows:

- Both attainment levels (supply) and educational requirements (demand) have increased over time, but attainment has increased faster than requirements, such that the incidence and the degree of overeducation has also risen. At the end of our data period (2022), approximately 40% of age-30-workers in Norway are overeducated, in the sense that they have higher education than what seems to be required in their occupation.

- There is a strong positive social gradient in the pattern of overeducation: It is more frequent and has risen much faster among offspring born into upper class families. At the same time, non-employment is more frequent and has risen much faster among offspring born into lower class families. The data are thus consistent with a bumping-down story, whereby overeducated offspring with advantaged family backgrounds outrank offspring with disadvantaged backgrounds in the competition for lower-skill jobs.

- Educational earnings premiums have increased considerably, but in contrast to what we have seen in the US and some other advanced economies, the increase is primarily related to high-school graduation. Over the past two decades, the value of a high-school degree (compared to no non-compulsory education) has increased by an amount corresponding to more than 10% of the average earnings level in Norway. Earnings differentials between college and high-school educated persons have not increased.

- Also in contrast to the US experience, the increasing returns to education in Norway seems to be fully accounted for by its rising influence on employment propensity. Conditional on employment, we find no evidence of increasing earnings premiums for either high-school or college/university education.

- The returns to education is much larger, and has increased more, when attainment is measured in terms of the highest obtained degree than when it is measured in terms of years actually spent in education.

- The positive employment effect of education is largest for offspring with a disadvantaged family background. Considering the returns to the time actually spent in education, we also find that the total educational premium is largest for bottom class offspring.

- Conditional on employment, we estimate that an additional year of (normed) highest completed degree raises the wage at age 32 by approximately 3.2%. However, when education is measured in terms of years actually spent (without conditioning on a successfully completed degree), the estimated returns to an extra year is cut by half to 1.6-1.8%.

- Overeducation is not wasted education, at least not from a private investment perspective. Conditional on employment, education having led to degrees beyond what is required in the occupation gives almost the same wage premium as the required years.

The findings that the rising returns to education is fully accounted for by the employment margin, and that it has increased more when education is measured in terms of highest degree than when it is measured in terms of time actually spent, suggest that it has not only been driven by its productivity-enhancing effects. Hence, it appears that the signaling channel of education has become more important, and, in particular, that a high-school degree to an increasing extent is used as a screening device also for jobs where the actual contents of a high-school degree seems irrelevant. A probable driver of this development is that attainment levels among young labor market entrants have increased more than educational requirements in available jobs, such that those without education are more often outranked by high-school graduates in the competition for low-skill jobs. The rising signaling-value of a high-school degree is in any case bad news for offspring born into lower-class families, as the cost of obtaining the high-school-signal is higher in these families.

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Appendix

Table A1. The 10 largest occupations within each skill-group

	Number of workers of age 30-33 in 2003	Percent of respective skill-group
Low-skill occupations (no non-compulsory education required)		
Shop salespersons and other salespersons (retail)	13012	21.71
Personal care and related workers not elsewhere classified	6863	11.45
Child-care workers	3728	6.22
Helpers and cleaners in offices and other establishments	3464	5.78
Stock clerks	3136	5.23
Salespersons (wholesale)	2789	4.65
Heavy truck and lorry drivers	2574	4.30
Head waiters, waiters, waitresses and bartenders	1541	2.57
Earth-moving and related plant operators	1193	1.99
Laborers in manufacturing	1183	1.97
Sum of 10 largest	39483	65.89
Medium-low-skill occupations (at least high-school required)		
Nursing assistants and care assistants	7432	10.59
Technical and commercial sales representatives	4302	6.13
Clerical officers	3586	5.11
Secretaries	3113	4.44
Electricians, electrical and electronic equipment mechanics and fitters	2771	3.95
Carpenters and joiners	2627	3.74
Computer associate professionals	2475	3.53
Motor vehicle mechanics and fitters	1852	2.64
Directors and chief executives (typically small businesses)	1656	2.36
Accounting and bookkeeping clerks	1529	2.18
Sum of 10 largest	31343	44.66
Medium-high-skill occupations (at least bachelor's level required)		
Primary education teaching professionals	10296	18.54
Other public service administrative professionals	6595	11.87
Nurses	5679	10.23
Preprimary education teaching professionals	3477	6.26
Computer systems designers and computer programmers	3452	6.22
Accountant associate professionals and bookkeepers	1856	3.34
Civil engineering technicians	1684	3.03
Journalists and information associate professionals	1402	2.52
Nursing and midwifery professionals	1305	2.35
Electronics and telecommunications engineering technicians	1236	2.23
Sum of 10 largest	36982	66.59
High-skill occupations (at least master's level required)		
Medical doctors	1506	19.33
College, university and higher education teaching professionals	1418	18.21
Lawyers	1007	12.93
Other engineers and related professionals not elsewhere classified	911	11.70
Mechanical engineers	529	6.79
Psychologists	511	6.56
Architects, town and traffic planners	482	6.19
Electronics and telecommunications engineers	435	5.58
Geologists and geophysicists	173	2.22
Pharmacists	137	1.76
Sum of 10 largest	7109	91.27

Note: The required education in an occupation is defined as the highest degree needed to account for at least 30% of age 30-33 workers in 2003.

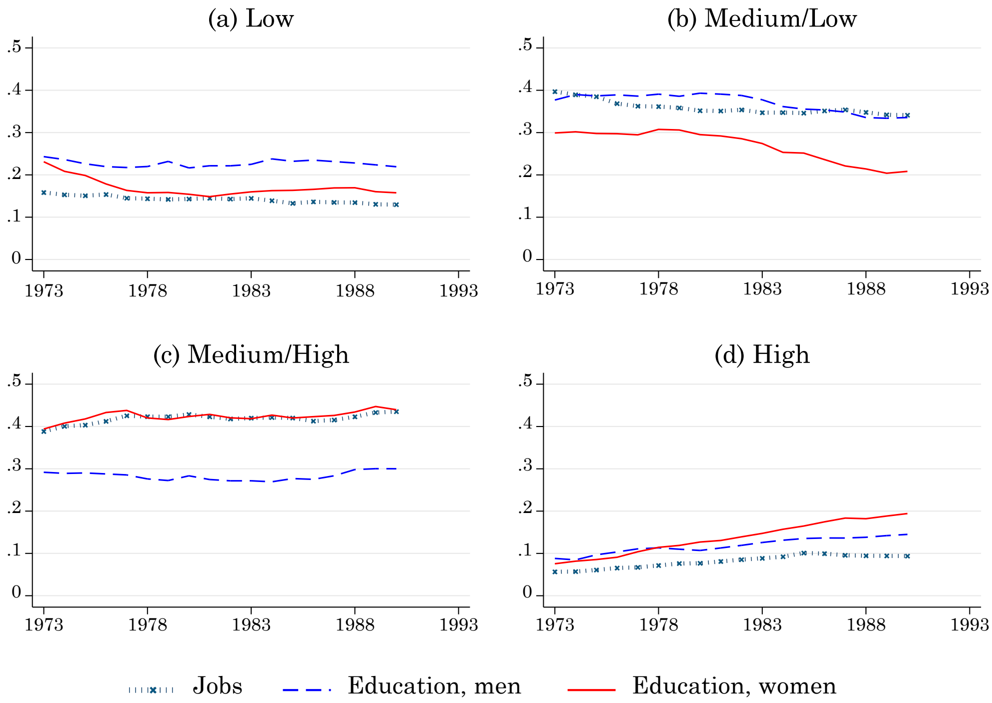

Figure A1. Highest completed degree and the distribution of educational job requirements by age 30 when the modal education in each occupation is used to define occupational requirements.

Note: Job requirements are measured for all employees in our data at age 30, and the "Jobs" lines show the fraction of jobs requiring no particular education (panel a), high-school (panel b), Bachelor's (panel c), and Master's (panel d). The "Education" lines show the fractions of the complete birth cohorts (including non-employed and self-employed) holding the corresponding attainment levels (highest degree).

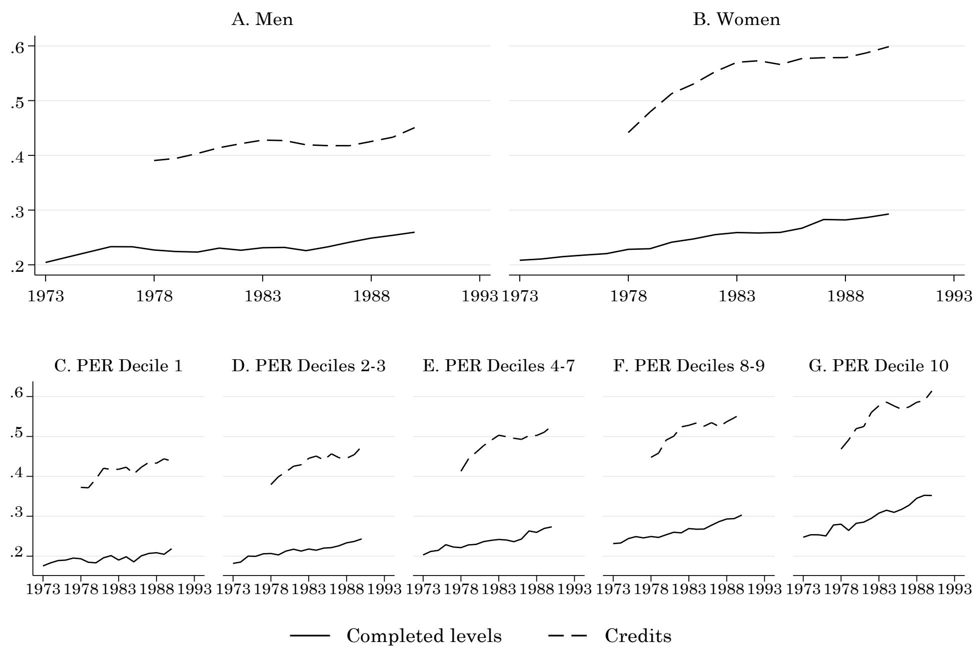

Figure A2. Fraction overeducated at age 30 by birth year when the modal education in each occupation is used to define occupational requirements. By gender and parental earnings rank.

Note: The data cover people employed at age 30. See Section 2.1 for the definitions of education and Section 2.3 for the identification of parental earnings rank.

Figure A3. Average years of overeducation (degree/credits minus required) among employees at age 30 by birth year when the modal education in each occupation is used to define occupational requirements. By gender and parental earnings rank.

Note: The data cover people employed at age 30. See Section 2.1 for the definitions of education and Section 2.3 for the identification of parental earnings rank.

Table A2. Earnings premium derived from highest completed degree. Unconditional of employment. By class.

	Total premium	Via employment	Via occupation	Within occupation
Bottom class (PER in decile 1)				
High school	145.046	121.530	0.405	23.110
	(3.285)	(2.803)	(1.270)	(2.204)
Bachelor's degree	81.509	39.488	46.680	-4.659
	(3.796)	(3.239)	(1.468)	(2.547)
Master's degree	143.153	27.499	86.035	29.619
	(6.576)	(5.611)	(2.543)	(4.412)
R-squared	0.745	0.737	0.683	0.636
No. observations	101134	101134	101134	101134
Lower class (PER in decile 2-3)				
High school	137.433	103.419	9.477	24.537
	(2.346)	(1.780)	(1.008)	(1.651)
Bachelor's degree	72.185	30.302	48.096	-6.213
	(2.250)	(1.707)	(0.967)	(1.583)
Master's degree	132.850	22.896	70.884	39.070
	(3.770)	(2.861)	(1.620)	(2.652)
R-squared	0.733	0.733	0.678	0.634
No. observations	206579	206579	206579	206579
Middle class (PER in decile 4-7)				
High school	132.204	96.738	11.471	23.994
	(1.932)	(1.286)	(0.854)	(1.408)
Bachelor's degree	71.404	29.868	46.178	-4.642
	(1.586)	(1.055)	(0.701)	(1.156)
Master's degree	135.988	26.673	69.296	40.018
	(2.111)	(1.405)	(0.933)	(1.539)
R-squared	0.710	0.716	0.665	0.616
No. observations	413584	413584	413584	413584
Upper class (PER in decile 8-9)				
High school	133.562	92.146	15.320	26.096
	(3.350)	(2.007)	(1.467)	(2.494)
Bachelor's degree	62.787	30.750	43.819	-11.782
	(2.526)	(1.514)	(1.106)	(1.881)
Master's degree	150.613	32.175	73.640	44.799
	(2.822)	(1.691)	(1.236)	(2.101)
R-squared	0.716	0.724	0.682	0.631
No. observations	206356	206356	206356	206356
Top class (PER in decile 10)				
High school	142.961	95.137	18.902	28.922
	(6.218)	(3.253)	(2.636)	(4.751)
Bachelor's degree	65.552	31.229	36.062	-1.739
	(4.322)	(2.261)	(1.832)	(3.302)
Master's degree	175.625	41.637	84.159	49.830
	(3.845)	(2.012)	(1.630)	(2.938)
R-squared	0.694	0.706	0.666	0.619
No. observations	103349	103349	103349	103349

Note: Based on all cohorts born 1973-1992. Earnings are measured in 1000 NOK inflated to 2022-value. See note to Figure 8 for details.