ECONOMIC MOBILITY UNDER PRESSURE

Simen Markussen
The Ragnar Frisch Centre
for Economic Research

Knut Røed
The Ragnar Frisch Centre
for Economic Research

Abstract
Based on complete population data, with the exact same definitions of family class background and economic outcomes for a large number of birth cohorts, we examine post-war trends in intergenerational economic mobility in Norway. Standard summary statistics indicate stable or mildly declining rank–rank mobility for sons and sharply declining mobility for daughters. The most conspicuous trend in the mobility patterns is that men and women born into the lowest parts of the parental earnings distribution have fallen behind in terms of own earnings rank, as well as a number of other quality-of-life indicators. A considerable part of this development can be explained by changes in the class distribution of educational attainment and in its rising influence on earnings rank. We argue that although the educational revolution has diminished the role of inherited ability, it has enlarged the influence of the family as provider of a social learning environment. (JEL: J62, D63, J24)

1. Introduction

The present paper contains an in-depth study of social and economic mobility trends in a typical welfare state economy, namely, Norway. Our analysis is based on fully comparable and virtually attrition-free parent–offspring data for all offspring born between 1952 and 1975. We examine the origins of trends in intergenerational class mobility in terms of the *transmission of*, as well as the *returns to*, cognitive

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E-mail: simen.markussen@frisch.uio.no (Markussen); knut.roed@frisch.uio.no (Røed)

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ability (IQ), and educational attainment. Our analysis incorporates an exceptionally wide range of offspring outcomes measured up to age 40, such as earnings and net income rank, earnings and net income share (earnings/income relative to the cohort average), employment, disability program participation, family formation, and mortality. Moreover, we take advantage of complete administrative registers covering almost a 50-year period to explore and assess alternative rank-based social background indicators, measured at alternative stages of the parents' lifecycle and grounded on alternative earnings concepts. As the primary basis for our empirical analysis, we choose the ranking algorithms that offer the best combined properties in terms of minimizing lifecycle and attenuation biases, facilitating a stable social class interpretation over time, and ensuring a symmetric and attrition-free implementation for all cohorts.[1] Our preferred social background indicator ends up being based on the sum of both parents' earnings during their respective ages 52–58, whereas our preferred offspring ranking is based on individual labor earnings during age 34–40. Conditional on survival to age 40 and continued residency in Norway at that point, our data then include consistently defined earnings ranks for both generations for more than 99% of every cohort born between 1952 and 1975.

Our findings show that the intergenerational earnings rank correlation for sons has fluctuated around a mildly rising trend, whereas for daughters, there has been a consistent and significant increase in the intergenerational earnings rank correlation throughout the period. As a result, the mobility patterns for sons and daughters have converged, and toward the end of the period we find that rank mobility is even lower for women than for men. When we look at economic outcomes by class background in more detail, we identify some quite powerful developments at the tails of the parental class distribution, the most conspicuous being that persons born into the lower classes have fallen considerably behind. For both sons and daughters, we find that those born into the lower economic classes do gradually worse, in terms of own economic rank as well as in terms of relative earnings and net (individual and household) income. For sons, this development is accompanied by a sharp decline in employment. For example, while men born into the lowest class vigintile in 1952 were 9 percentage points less likely to be employed at prime age (34–40) than those born into the highest class vigintile, this differential had increased to 19 percentage points for men born in 1975. For both men and women, we identify a sharp increase in the class gradient of disability program participation (at age 40), and also a small increase in the class gradient of mortality (between age 18 and 40). Mortality rates dropped for all classes, but the drop was smaller at the bottom of the class distribution.

For all generations studied in this paper, we identify a marked class gradient in the chances of finding a life partner (becoming married and/or a parent by age 40) for men,

1. We use the term "social class" in this paper as label for parental earnings rank to emphasize that we think of this metric not only as measure of available economic resources, but as a much wider indicator of family background, including social and cultural status, human capital resources, and access to influential networks. We realize that the social class concept in the research literature is typically viewed as more complex, and that its definition, interpretation and operationalization are widely debated within the social sciences.

but no such gradient for women. This is in line with theories of hypergamy, suggesting that women give higher priority to a prospective partner's economic potential than men do when they chose a life companion; see Almås et al. (2019). Based on this theory, we would expect the class gradient in men's marital chances to become steeper in line with the class gradient in economic outcomes. And this is exactly what we see. In particular, we show that men born into the bottom of the economic class distribution have reduced their marital chances considerably relative to men with more advantageous family background. Hence, lower class men have apparently lost out along all the quality-of-life dimensions of employment, earnings, living standard, health, companionship, and life expectancy.

The theoretical literature on economic mobility highlights that intergenerational persistence in economic outcomes operates through the heritability of earning-related traits as well as through investments in human capital, see, for example, Becker and Tomes (1979, 1986) and Solon (1999, 2004, Chap. 2). Hence, in order to identify the mechanisms behind the changing patterns of class mobility, we examine the trends in the intergenerational transmission of human capital and its economic returns. Human capital has two dimensions in our analysis. The first is cognitive ability, which we measure by ability scores obtained in IQ tests administered by the armed forces to all Norwegian boys aged 18–19. With some qualifications, we will generally think of this as a proxy for the genetically inherited part of human capital. The second is educational attainment, which we measure as the highest completed education by age 40.

From a policy perspective, it is important to find out why mobility out of the lower classes has declined, and in particular to understand the distinct roles of the intergenerational transfer of *ability*, on the one hand, and the transfer of *opportunities given ability*, on the other. Although we normally think of higher class persistence as undesirable, as it reflects less *equality of opportunities* in the offspring generation, it may also arise from a transition toward a more mobile and fluid society in the parent generation.[2] In particular, to the extent that the intergenerational transmission mechanisms involve a genetic transfer of ability, we would expect that societal changes in the parent generation toward meritocracy lead to a period of declining observed class mobility for their offspring, as the higher correlation between class and ability in the parent generation induces a higher correlation between ability and class also

2. Although equality of opportunities is a widely accepted aim of economic and social policies, it might be neither possible nor desirable to remove the influence of family background completely. Following in the footsteps of Rawls (1958, 1971), Dworkin (1981a, 1981b), and Sen (1985, 1992), there has been a lively debate among economists regarding the normative foundation for redistributive policies that compensate for differences in biologically and socially inherited abilities and preferences, see Roemer and Trannoy (2015, Chap. 4) or Ramos and Van de gaer (2016) for recent surveys. There is a large empirical literature comparing the degree of intergenerational mobility across countries. The highest mobility is typically found in the Nordic welfare states and the lowest mobility is observed in the United States, with the central European countries somewhere between (Corak 2006; Jäntti et al. 2006; Black and Devereux 2011; Blanden 2013; Bratberg et al. 2017). There is also considerable variation within countries, and some regions in the United States appear to have mobility levels similar to the Nordic countries (Chetty et al. 2014a).

in the offspring generation; see Nybom and Stuhler (2014). However, our findings do not support this meritocracy hypothesis. The stronger association between parent and offspring outcomes at the bottom of the class distribution is *not* an artefact of a higher correlation between economic success and cognitive ability *within* the parent generation. Although there indeed is a strong class gradient in cognitive ability, there is no evidence that it has become steeper over time. In particular, the share of low ability offspring has not systematically shifted toward the bottom classes.

Yet, it could still be the case that the declining mobility out of the bottom classes tells a story that is more about inherited cognitive ability than about class. Even a stable class gradient in the ability distribution may be responsible for declining mobility if the economic returns to ability increase. However, recent empirical evidence suggests otherwise. If anything, the economic returns to cognitive ability has declined over the past few decades, see, for example, Castex and Dechter (2014) and Edin et al. (2017). This is also largely confirmed by our data. We find that the difference in earnings rank outcomes between sons with high and low cognitive ability, conditional on class, has been *reduced* over time. The lower average ability level among offspring in the lower economic classes has therefore been a force for increased earnings rank mobility, ceteris paribus.

Why have the rank returns to cognitive ability declined? Recent research point to the rising value of social skills in the labor market, as computers are still poor at substituting for human interaction (Deming 2017); and empirical evidence indicates a considerable increase in the economic returns to noncognitive abilities over the past few decades (Edin et al. 2017). While our data do not allow us to investigate the role of noncognitive skills, we present evidence indicating that one important (additional) explanation can be found in the massive expansion of educational capacity during the post-war period, which made secondary and tertiary education accessible to a much larger share of the population, *including those with lower cognitive ability*. The increasing supply of educational opportunities *substituted* for (lack of) innate cognitive ability in the production of offspring's outcomes, and this leveled the playing field across ability groups. However, it did not level the playing field across classes in the same fashion. While low-ability offspring raised their relative educational attainment considerably, there was no such relative upgrading in the lower classes—despite their higher share of low-ability offspring. At the same time, the economic returns to education increased, thus enlarging the handicap of being at the bottom of the educational attainment distribution.

Given that education at all levels in Norway is provided by the government free of charge and with a purely qualification-based admittance policy, it is perhaps surprising that there is a steep social gradient in educational attainment, and that the large expansions of the educational system in the post-war period have not managed to lift the relative educational achievements of the lower classes. However, the finding that the class gradient in educational attainment is not eradicated by the removal of tuition fees accords well with existing empirical evidence showing that the influence of family background on educational attainment is considerable both in countries with and without such fees, see, for example, Hertz et al. (2007) and Landersø and Heckman

(2017).[3] The reason is that there appears to be a class gradient in the capability of taking advantage of free educational opportunities also. A plausible explanation for this is found in an empirical literature showing that family support and encouragement are important inputs in the production of educational outcomes and that lower-class families provide less such encouragement and support, see Mayer et al. (2015). In particular, it has been documented that economically advantaged parents on average produce more cognitively stimulating home learning environments, and spend more time on supporting their children's education (Guryan, Hurst, and Kearney 2008; Kalil, Ryan, and Corey 2012). 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.

The findings reported in this paper add to a small empirical literature on post-war trends intergenerational economic mobility. Most of the contributions to this literature have examined the development of intergenerational earnings elasticities and/or brother correlations, and have thus, in contrast to our own contribution, primarily focused on economic mobility *conditional* on employment (or positive earnings/income). Important contributions to this literature include Hertz (2007) and Lee and Solon (2009) for the United States, Blanden et al. (2004) and Nicoletti and Ermisch (2007) for the United Kingdom, Lefranc and Trannoy (2005) for France, Björklund, Jäntti, and Lindquist (2009) for Sweden, Pekkala and Lucas (2007) for Finland, and Bratberg, Nilsen, and Vaage (2005) and Hansen (2010) for Norway.[4]

More recent contributions also incorporate trends in intergenerational rank–rank associations, and are thus more similar to the approach used to study earnings mobility in the present paper. For the United States, this includes Chetty et al. (2014b), who present intergenerational family income rank–rank slopes for offspring born between 1971 and 1993, based on administrative tax returns data. Offspring incomes are recorded somewhat differently for different birth cohorts, however, due

3. Landersø and Heckman (2017) compare the intergenerational educational mobility patterns in Denmark and the United States and argue that they are "remarkably similar". Their analysis has been challenged, however, by Andrade and Thomson (2018), who have reanalyzed the same data, but come to the conclusion that the mobility is significantly higher in Denmark.

4. The Nordic studies are all based on administrative registers, whereas the U.S., U.K., and French studies referred to here are all based on survey data: The Panel Study of Income Dynamics (PSID) for the United States, the National Child Development Study (NCDS) and the British Cohort Survey (BCS) for the United Kingdom, and the Education-Training-Employment (FQP) survey for France. All the studies mentioned here also differ in the choice of age for earnings measurement and/or in the way this is controlled for in the analysis. Although there appears to be a general agreement that intergenerational mobility has declined for women, the results for men differ; from increased mobility (Bratberg, Nilsen, and Vaage 2005 for Norway), via stable mobility (Hertz 2007; Lee and Solon 2009, for the United States, Lefranc and Trannoy 2005, for France, and Hansen 2010, for Norway), to declining mobility (Blanden et al. 2004; Nicoletti and Ermisch 2007, for the United Kingdom; Björklund, Jäntti, and Lindquist 2009, for Sweden, and Pekkala and Lucas 2007, for Finland).

to incomplete data.[5] The main conclusion is that intergenerational mobility has been stable throughout the period, with rank–rank correlations around 0.30. Pekkarinen, Salvanes, and Sarvimäki (2017) report trends in intergenerational rank–rank earnings mobility for sons born in Norway between 1932 and 1974. In the main part of the analysis, offspring earnings are recorded at age 35 for all cohorts, whereas the earnings of fathers are recorded between age 55 and 64. A key finding is that the rank–rank correlation coefficient has remained remarkably stable around 0.19 for all post-war birth cohorts.

It follows from this brief review that there is a small existing literature studying mobility trends in Norway (Bratberg, Nilsen, and Vaage 2005; Hansen 2010; Pekkarinen, Salvanes, and Sarvimäki 2017).[6] Our paper complements this literature in at least three ways: First, we examine a wide range of quality-of-life outcomes, not only related to labor earnings, but also to consumption possibilities (net household income), health (disability insurance claims), companionship (family formation), and mortality. This is important in our context, as it reveals a remarkably systematic deterioration of quality-of-life outcomes for offspring born into the lowest economic classes. Second, as outlined previously, we present a novel analysis of the mechanisms behind the observed decline in earnings rank–rank mobility, with a focus on the intergenerational transfer of and the returns to both (the largely inherited) cognitive ability (IQ) and educational attainment. A key finding is that while the educational revolution has made the largely genetic transmission of ability less critical for intergenerational mobility, it has magnified the influence of the social/environmental transmission mechanism. Finally, as a foundation for our empirical analysis, we offer a systematic assessment of how mothers' and fathers' earnings can be combined to provide the best and most stable class-ranking algorithm. This is critical for the assessment of trends in intergenerational mobility, as the economic roles of mothers and fathers have changed considerably over time.

2. Data and Identification of Economic Class

The analysis in this paper is based on encrypted complete administrative register data for Norway with inter- and intragenerational (legal) family linkages. The earnings data comprise all reported pension-point generating labor earnings, including both wages and self-employment income. They are available for all residents on an annual basis from 1967 to 2015; hence they provide information about considerable parts of the earnings histories for a large number of birth cohorts. For a few birth cohorts

5. Incomes are recorded at age 29–30 for the 1971–1982 cohorts, and forecasted for the same age-interval on the basis of recorded income at age 26 or college attendance for the 1983–1986 and 1987–1993 cohorts, respectively. Parents' incomes are measured when the offspring were aged 15–19.

6. There is also a more vaguely related paper (Modalsli 2017) examining occupational father–son mobility in Norway between 1865 and 2011, based on interviews or mail-in forms from censuses (for the years 1865, 1900, 1910, 1960, 1970, and 1980) and register data (for 2011).

they provide complete lifecycle earnings histories. In addition to earnings data, we exploit a number of other administrative data sources to capture alternative quality-of-life outcomes and their determinants. These include data on total (individual and household) net income (from 1993), educational attainment, cognitive ability (men only, based on tests done at enrolment to military service), disability insurance claims (from 1992), mortality, and marital status/parenthood.

Based on earnings data for the parent generation, we identify social/economic background for all persons born in Norway from 1952 through 1975. While much of the economics literature on social mobility focuses on intergenerational associations of earnings (or income) levels, the analysis in the present paper builds entirely on a rank-based understanding of economic background. A rank-based measure of economic background has the, for our purpose important, advantages that it can be constructed for everyone (regardless of labor force participation) and that it *by construction* exhibit exactly the same marginal distribution for all birth cohorts. In the analysis of intergenerational earnings mobility, we will use rank measures for both generations, in line with recent contributions by Dahl and DeLeire (2008), Chetty et al. (2014a, 2014b), Corak, Lindquist, and Mazumder (2014), Bratberg et al. (2017), and Pekkarinen, Salvanes, and Sarvimäki (2017).

An earnings-based ranking criterion has similarities with the class rankings based on education or occupation frequently encountered in the sociology literature, see Blanden (2013) for a recent survey. However, in contrast to education and occupation—which is subjected to huge changes in distribution and social status over time—earnings rank has a reasonably stable class interpretation across birth cohorts, particularly if it is based on permanent labor earnings. The idea that class background is best represented by the parents' permanent (or lifetime) labor earnings encapsulates a number of plausible transmission mechanisms beyond the direct parental economic investments, such as genetic and environmental transfer of ability, self-confidence, and work ethic, impacts of social status, access to influential networks, and peer influences.

In Online Appendix A, we examine a range of alternative specific earnings rank criteria for the parent and offspring generations. As a foundation for our main analysis, we choose the ranking algorithms that we consider to best balance the following criteria: (i) that they can be implemented without attrition and in exactly the same fashion for all the cohorts included in our analysis, (ii) that they come as close as possible to rankings based on lifetime earnings, with a minimum of attrition bias, and (iii) that they have a stable social class interpretation over time. This leads us to use the *sum* of both parents' earnings during their respective ages 52–58 (7 years) as a foundation for assignment of the offspring's class background.[7] For the offspring generation, we base our primary rank outcome on total individual earnings during age 34–40 (also 7 years). By using this particular age span we seek to minimize the

7. We show in the Online Appendix A that this is the part of the lifecycle for which annual labor earnings are most highly correlated with lifetime labor earnings.

potentially time-varying sources of lifecycle bias related to cohort-specific patterns in the evolution of earnings distributions over age, see Nybom and Stuhler (2016). At the same time, these rank criteria have the advantage that they can be computed in exactly the same fashion for all persons born in Norway from 1952 through 1975 (with more than 99% coverage for every cohort). Each of these birth cohorts consist of 50–55,000 individuals, giving us a total sample of 1.3 million observations; see Table A.1 in Online Appendix A.

As we explain in more detail in what follows, we implement in this paper an economic family background ranking based on 20 bins—or *vigintiles* (sometimes also referred to as ventiles). That is, the members of each annual birth cohort of sons/daughters are divided into 20 *economic classes* based on their parents' earnings, where class 1 contains the 5% of offspring with parents in the lowest earnings bin, and class 20 contains the 5% with parents in the highest earnings bin (more details on how we do this is given in what follows). There are two reasons why we settle for 20 classes rather than the 100 percentiles used by, for example, Chetty et al. (2014a). The first is that we then circumvent the problem that more than 1% of the families tend to have zero earnings, which makes it difficult to provide a meaningful fine-grained classification at the bottom of the earnings distribution.[8] The second is that it reduces disturbing noise in settings where we have few observations. This choice is not essential for our conclusions, however. Online Appendix B presents some results based on percentile ranks.

As we use the resultant earnings ranks to establish economic class background as well as the offspring's own economic outcomes, it may be of interest to see how large the earnings differences actually are between the vigintiles in parent and offspring generations, and also to check whether the degree of inequality has changed over time. Figure 1, panel (a), reports the fraction of overall parental earnings allocated to each vigintile for the parents of the first six and the last six of the birth cohorts used in our study. It illustrates that the earnings distribution is quite compressed, and also that it has been remarkably stable over the parent generations examined in this paper. For both periods, only the very top parent vigintile obtained more than 10% of total earnings, and only the very bottom vigintile obtained less than 2%. When we compare the parents of the 1952–1957 birth cohorts with the parents of the 1970–1975 birth-cohorts, the only change of interest is that the fraction of earnings earned by the very top vigintile increased, at the cost of small share reductions for most other vigintiles. Moving on to the sons and daughters' individual labor earnings in panels (b) and (c), we see similar earnings share distributions. However, while we see signs of increasing inequality among sons, the inequality among daughters has declined—and also become much more similar to that of sons.

8. With the earnings concepts used in this paper, the number of zeros never exceeds 5%.

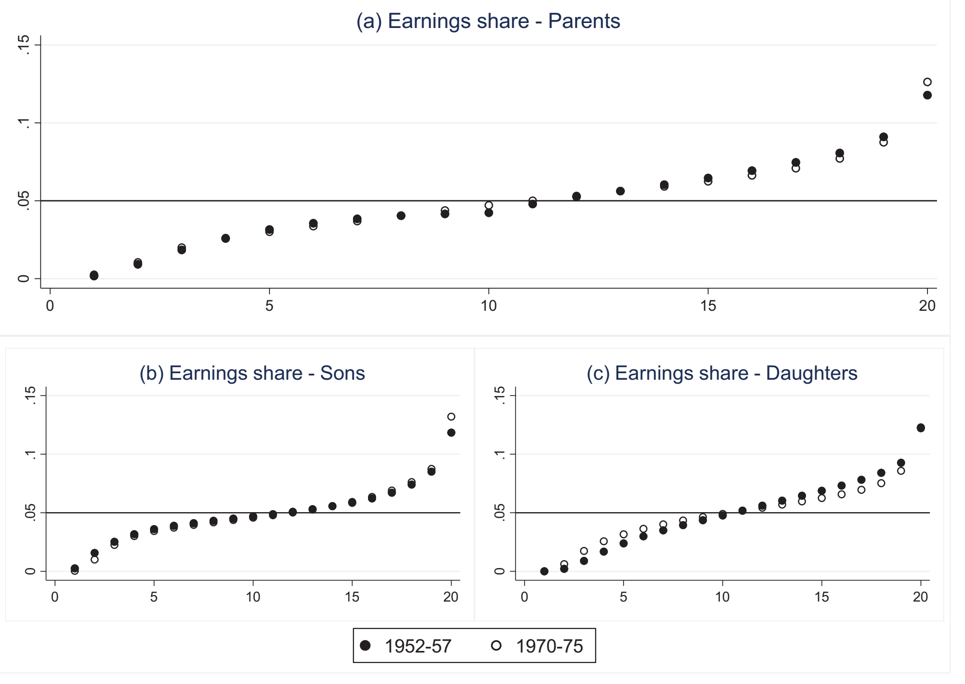

FIGURE 1. The intragenerational distribution of parental (panel (a)) and offspring (panels (b) and (c)) earnings. By vigintile. Panel (a) shows the vigintile shares of total earnings for the sum of the two parents' earnings during their respective ages 52–58. Panels (b) and (c) show vigintile shares for offspring earnings during their age 34–40.

3. Trends in Intergenerational Mobility

In this section, we examine the associations between economic class (as defined by parents' earnings rank) and a number of offspring quality-of-life outcomes, birth cohort by birth cohort. Our outcomes include a range of welfare indicators, that is, earnings rank, earnings share, employment, net income (consumption opportunities), health (disability program participation), companionship (family formation), and mortality. The findings are presented graphically, and we alternate between two expository approaches. First, in order to assess the nature of the changes in intergenerational class mobility that have occurred between the beginning and the end of our data period, we compare the complete vigintile outcome distributions for selected early and late birth cohorts. Second, in order to assess the time trends in overall class mobility as well as mobility out of the bottom and top classes, we present some summary statistics for each birth cohort. For these latter statistics, we also show illustrative trend lines based on local polynomial (second order) regressions.

For all the statistics presented in this section, we have assessed the statistical uncertainty by means of a nonparametric bootstrap, that is, we have randomly resampled (with replacement) 120 distinct datasets consisting of sons and daughters and used those to compute confidence intervals for the statistics of interest. For expository reasons, we will not show standard errors or confidence intervals for all the numbers that we present in what follows. However, we do present confidence intervals for the summary statistics' trend lines. For the large number of cohort- and vigintile-specific data-points, we will convey information about the significance of observed changes by marking differences that are not statistically significant at the 5% level with an "x" below the data points in question.

3.1. Earnings

To see how the associations between offspring's economic outcomes and their class background have evolved over time, we start out in Figure 2 with a graphical display of earnings outcomes *by class background*. Panels (a)–(d) first show average earnings rank and earnings shares (earnings relative to the gender-specific cohort average) for the first and the last six birth cohorts for which we have access to fully comparable earnings data in both generations, that is, for the cohorts born in 1952–1957 and 1970–1975. The statistics presented in these panels are estimated with high statistical precision. For each vigintile, typical standard errors for the rank-outcomes are around 0.06 and for the share-outcomes 0.004; and 95% confidence intervals cover approximately the sizes of the dots in each figure. As a rule of thumb, a difference between the early and late cohorts is statistically significant at conventional levels insofar as the data points in the figure are clearly distinguishable; confer the *x*-marking of nonsignificant differences. To facilitate interpretation, we include in each panel horizontal lines indicating perfect mobility, in which case the expected vigintile rank would have been 10.5 and the expected relative earnings would have been exactly one for all classes.

For both sons and daughters, we see patterns of relatively high economic mobility. Regardless of family background, the expected own vigintile rank is somewhere between 8 and 14, and each class' earnings levels relative to the cohort average is between 0.7 and 1.4 throughout the period covered by our data. However, there appears to have been a decline in economic mobility, particularly in the form of more persistence at the bottom of the class distribution. For sons, it is notable that we obtain a very similar picture of mobility patterns whether we look at earnings rank or earnings share. This is not surprising, given that the degree of inequality across earnings ranks remained almost unchanged over the cohorts studied in this paper, cf. Figure 1. There is one conspicuous exception from this pattern, though, namely that the extreme upper vigintile raised their earnings share despite a small drop in earnings rank. As illustrated in the two lower panels of Figure 2(g) and (h), the declining mobility out of the bottom classes is a result of a stable negative trend. The average number of classes crossed (the absolute difference between own and parental rank) has declined over the whole period for those born into the lowest vigintile. For sons born after 1960, there has also been a pattern of increasing (downward) earnings rank mobility out of the top class vigintile.

In order to examine the overall time trends in economic mobility in more detail we show in panels (e) and (f) intergenerational rank correlation (IRC) for each birth

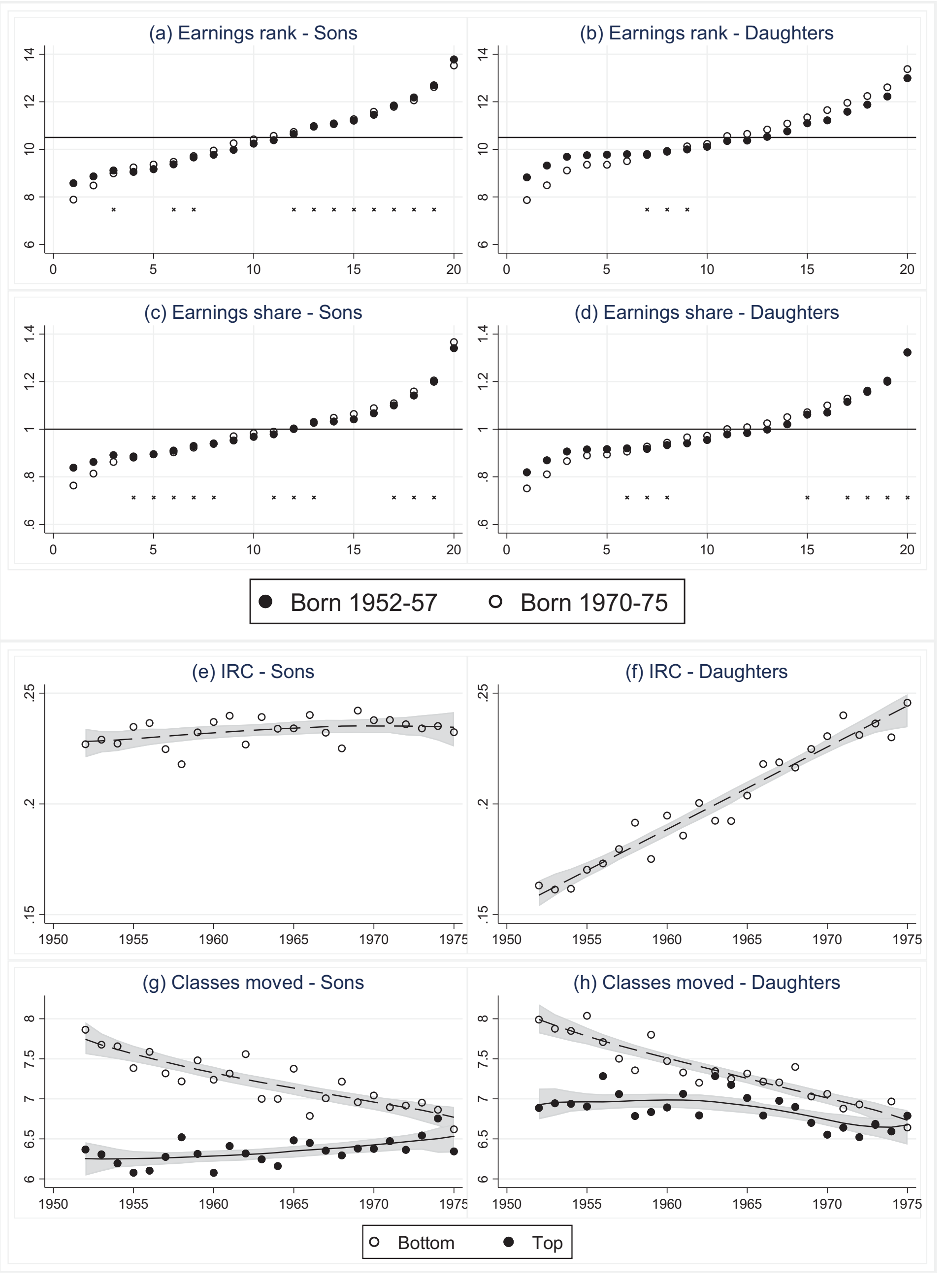

FIGURE 2. Indicators of offspring prime age earnings by economic class and birth year. The horizontal lines at 10.5 (in panels (a) and (b)) and at 1 (in panels (c) and (d)) are the *perfect mobility lines.* Economic class (vigintile rank from 1 to 20) on the horizontal axis in panels (a)–(d) is assigned based on the sum of parents' earnings obtained during their respective ages 52–58. Offspring earnings are measured as the sum of own earnings during age 34–40. Both parental and offspring earnings include self-employment earnings. An "x" below two data-points in panels (a)–(d) indicates

cohort, that is, the correlation between the parents' and the offspring's rank in their respective cohorts' earnings distributions. This statistic has been frequently used in the literature as a summary measure for class mobility, see, for example, Dahl and DeLeire (2008), Chetty et al. (2014a), and Bratberg et al. (2017). Note that since the variances of the rank outcomes by construction are equal for all generations, the correlation coefficient is here equivalent to the rank–rank regression slope. For sons, we find indications of stable or mildly decreasing overall earnings mobility. Comparing the first and the last six birth cohorts, IRC increased from 0.230 to 0.236, that is, by 0.6 points (just statistically significant at the 10% level). The finding of a relatively stable rank correlation for men is in line with Pekkarinen, Salvanes, and Sarvimäki (2017), although they report a considerably lower IRC at approximately 0.19 throughout the period. However, their analysis is based on fathers' earnings only, and on sons' earnings measured at age 35. When we replicate this strategy and establish the ranks on the basis fathers' earnings only and measure the sons' earnings at age 35, we obtain almost exactly the same results as those reported in Pekkarinen, Salvanes, and Sarvimäki (2017), with a stable rank correlation around 0.19 (not reported in the figure). For daughters, we have apparently seen a considerable decline in mobility. The rank correlation has increased from around 0.17 to 0.25, and for the last cohorts entering our analysis, the degree of rank–rank mobility for daughters is lower than for sons. The much steeper increase in IRC for women than for men is strongly related to the corresponding increase in female labor force participation over the same period. As we show in Section 3.5, when focusing on household income instead of individual earnings, the two trends become much more similar, with the rise in IRC actually being a bit larger for sons than for daughters.

As much of the existing literature on intergenerational rank–rank associations is based on percentiles rather than vigintiles, it may be of some interest to see how the choice of bin size influences the analysis. In Online Appendix B, we report a version of Figure 2 that is completely based on percentiles instead of vigintiles. To deal with the fact that more than 1% of the population has zero earnings, this strategy requires that we randomize the zero earnings observations across the relevant bottom percentiles. Apart from looking a bit noisier, the message coming out of the percentile approach is in our case very similar to that reported on the basis of vigintiles. When using vigintiles, it is also easier to examine the complete parent–offspring rank distributions, and in Online Appendix C, we show these for offspring born in 1952–1957 and 1970–1975.

Although IRC provides a comprehensive picture of the intergenerational rank–rank relationship when this relationship is linear (as it apparently is in the United States, see Chetty et al. 2014a), the nonlinearities displayed in panels (a) and (b) suggest that it is not necessarily the most appropriate summary measure for Norway. An alternative

FIGURE 2. (Continued) that the difference between the two observations is not statistically significant at the 5% level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

summary measure that has been used in the literature is the average number of classes crossed, that is, the absolute difference between parent's and offspring's economic position in their respective generations (Bartholomew 1982). Another is the Kendall's τ, which is an ordinal association measure representing the degree of concordance in the expected sign of pairwise parent–offspring earnings differences.[9] In Online Appendix D, we show that both these measures display trends in rank mobility that are very similar to those reported for IRC.

Our interpretations of the trends in the intergenerational rank–rank mobility rely on a stable class interpretation of the parental earnings rank measure. In order to assess robustness of our summary measures, we report in Online Appendix E trends in sibling rank correlations and in sibling absolute rank distances also. By using siblings, we circumvent completely the need for characterizing the class of parents. This is of course a broader measure of social background than the intergenerational one, as it incorporates all conditions shared by siblings, also those uncorrelated to parental earnings, see, for example, Solon (1999), Österbacka (2001), Björklund et al. (2002), Björklund, Jäntti, and Lindquist (2009), and Björklund and Jäntti (2012). However, it may still convey potentially valuable information about trends in the influences of family background. As it turns out, we find that the sibling-based measures display similar time trends as the rank correlations reported in Figure 2, for both brothers and sisters, that is, declining mobility throughout the period, see Online Appendix E for details.

3.2. Employment

Figure 3 illustrates how the changes in earnings ranks and shares are related to changes in employment patterns. We have defined a person as employed in the age 34–40 period if average annual earnings during these years exceeded approximately 1/3 of average full-time-full-year earnings in Norway.[10] For men, panel (a) shows that employment rates have declined for all classes below the median, and they have declined more the lower is the parental class rank. For sons from the lowest classes, the employment rates have dropped by almost 7 percentage points. For women, the pattern is quite different, and the daughters' employment rates have increased in all classes, see panel (b). Again, we see indications of convergence between the male and female mobility patterns. And for both sons and daughters, it is notable that there has emerged a quite conspicuous class gradient in employment, which for men was much less pronounced for those born in the 1950 s. The steeper class gradient in employment

9. A pair of parent-offspring couples are said to be concordant if the difference in earnings between the involved parents has the same sign as the corresponding difference between the involved offspring. If the differences have different sign, the pairs are discordant.

10. More precisely, we require average annual earnings during these years to exceed 2 times the so-called basic amount (BA) in the Norwegian pension system, which is adjusted each year approximately in line with the general wage growth. This definition of employment implies that it can be satisfied by having a very weak attachment to the labor market over many years or by having a strong attachment over just a few years.

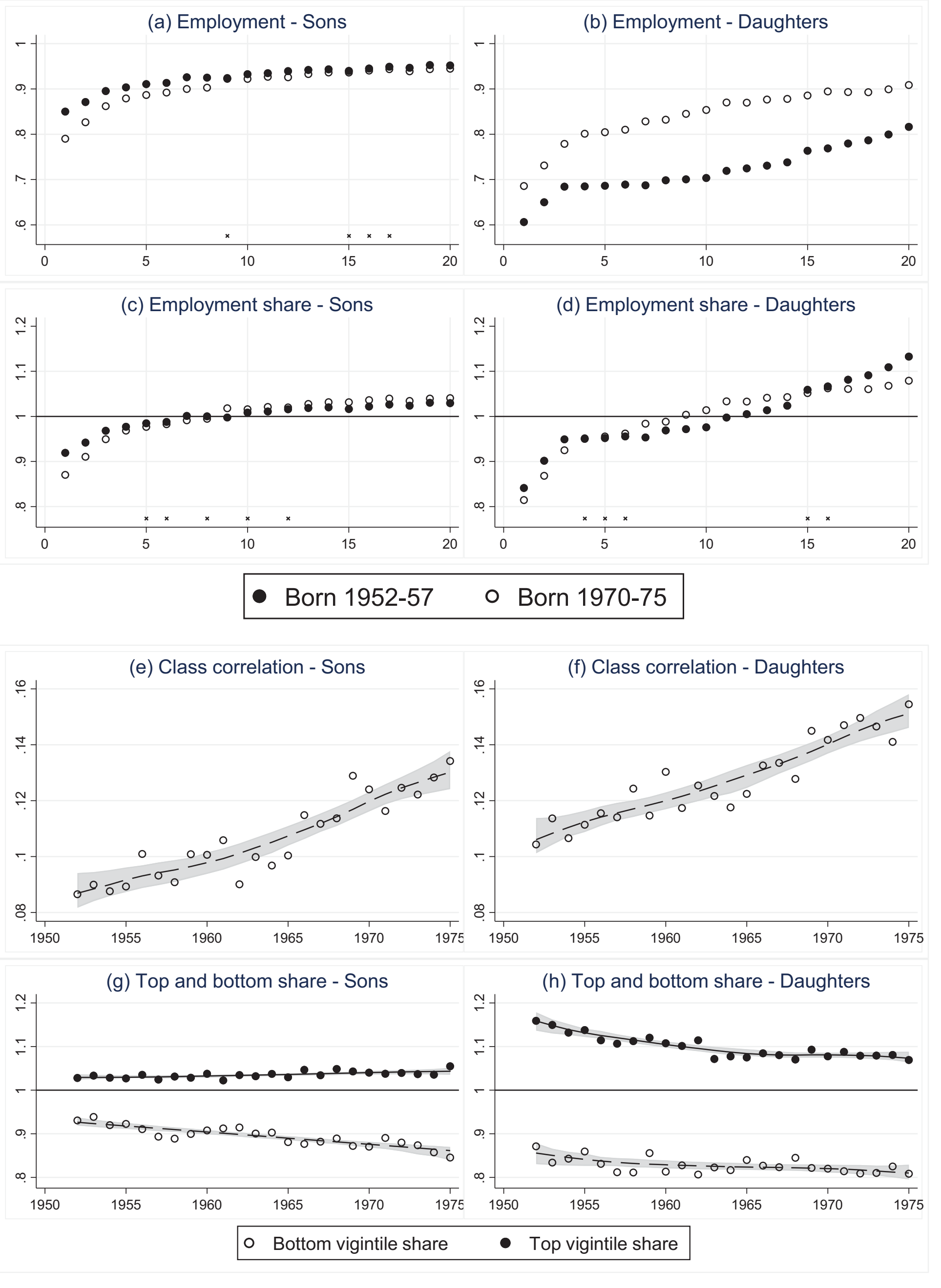

FIGURE 3. Prime age employment by economic class and birth year. Employment is defined as having average annual earnings during age 34–40 above a level corresponding to approximately 1/3 of average full-time full-year earnings in Norway. A class's employment share is the employment rate in the class relative to the average employment rate in the birth cohort. An "x" below two data-points in panels (a)–(d) indicates that the difference between the two observations is not statistically

primarily reflects that the lower ranked earnings outcomes to an increasing extent have become dominated by nonemployed individuals, and not that class mobility has changed per se. However, at the bottom of the class distribution, we would have seen a considerable decline in employment levels even if employment rates had remained constant at all parts of the earnings rank distribution. Based on the counterfactual assumption that employment rates were indeed constant at all outcome rank levels, we show in Online Appendix F how much of the class specific changes in employment rates that can be explained by the reallocation of rank outcomes only. For men in the bottom class vigintile, the reduced upward rank mobility accounts for as much as 42% of the decline in employment. For the second and third vigintiles, reduced mobility accounts for 34% and 23% of the drop, respectively. For the other vigintiles, the changes in rank mobility have only had negligible effects on employment.

Panels (c) and (d) further illustrate the class distribution of employment by plotting employment rates for each class relative to the cohort average. For men, it then becomes clearer that the class gradient in employment has become steeper throughout the class distribution, whereas for women, the class gradient has become less steep for all classes above the seventh vigintile. The four lower panels of Figure 3 examine the association between parental rank and own employment status, birth cohort by birth cohort. Panels (e) and (f) show that the correlation between parental rank and employment status has become more positive, year-by-year, for both sons and daughters. Panels (g) and (h) then present the employment rates in the bottom and top class vigintiles, relative to average employment for each cohort. The pattern displayed for sons in panel (g) confirms that the declining relative employment rate for lower class offspring is the result of a monotonous negative trend.

3.3. Disability Insurance

Figure 4 presents the evolvement of disability insurance (DI) program participation (temporary or permanent) by age 40.[11] The DI programs are by far the largest social insurance programs in Norway, covering roughly 15% of the working-age population at any time. The eligibility requirement is that a person's work capacity is reduced by at least 50% due to a health problem, and this needs to be certified by a physician and verified by the social security administration; see Fevang, Hardoy, and Røed (2017) for details. The replacement rate is approximately two thirds of estimated forgone

FIGURE 3. (Continued) significant at the 5% level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

11. The reason why we focus on claims made at age 40 (and not in the years before) is that these are the claims that can be identified in a perfectly symmetric fashion for all the birth cohorts entering our analysis on the basis of administrative register data (as we do not have information about claims made before 1992).

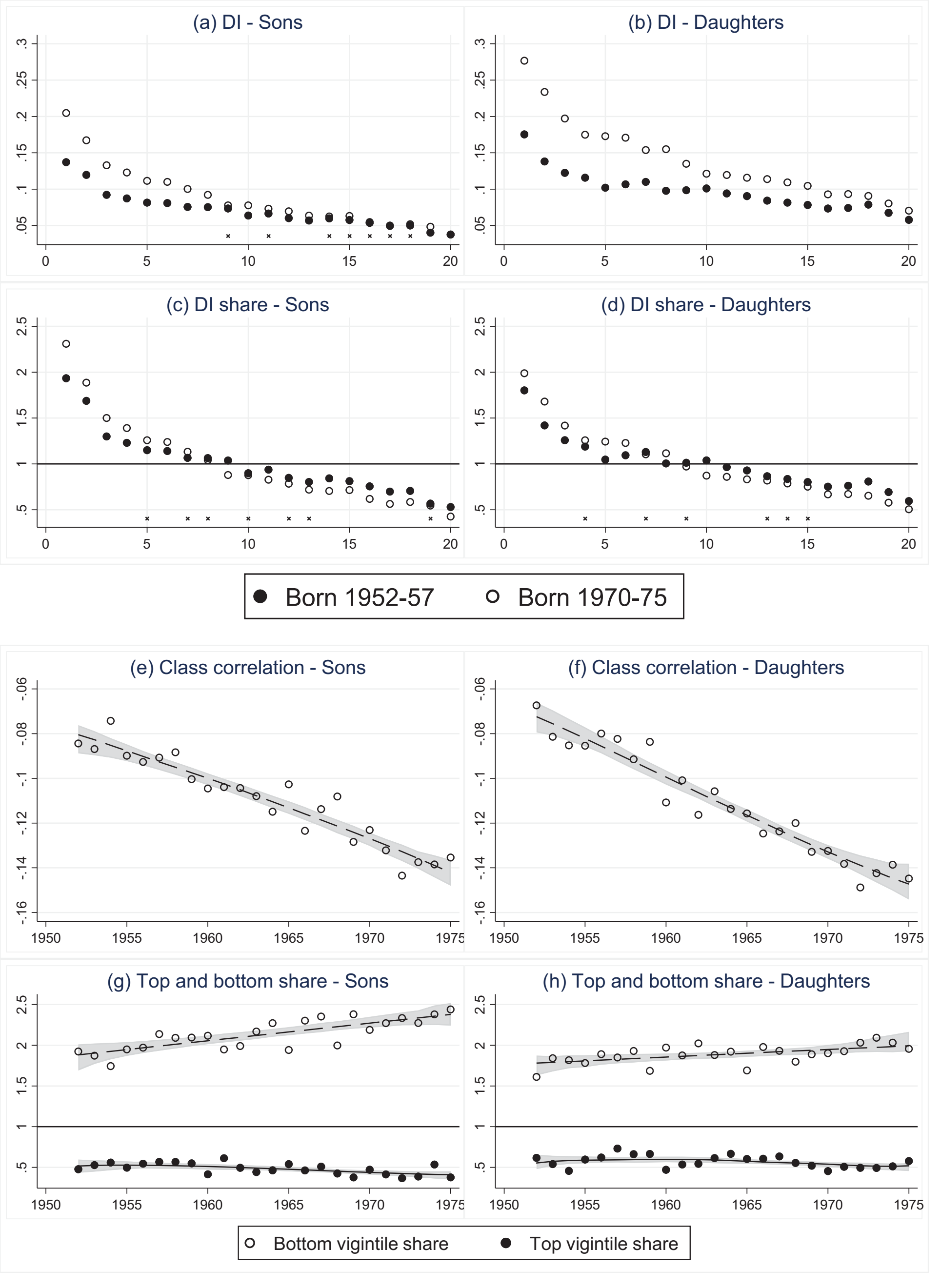

FIGURE 4. Disability program participation by economic class and birth year. Disability program participation (DI) is set to unity if a disability insurance benefit was received during the calendar year of the 40th birthday. Panels (a) and (b) show disability program participation rates by class background. Panels (c) and (d) show the DI participation rates in each class relative to the cohort average. Panels (e) and (f) show the correlation between disability program participation and class

earnings (calculated on the basis of past earnings). Panels (a) and (b) first show that there has been a considerable increase in disability program participation from the 1950s to the 1970s birth cohorts; and for both sons and daughters it is evident that the increase is larger the lower is the class background. As a result, the shares of the disability program participants that come from the lower classes have increased sharply (panels (c) and (d)). The correlation between DI and economic class has also gradually become more negative (panels (e) and (f)), and the share of DI claims accounted for by the bottom vigintile has increased considerably, particularly among sons (panels (g) and (h)). It is notable that virtually all the graphs in Figure 4 look like mirror images of those in Figure 3, reflecting that the main alternative to prime age employment in Norway, particularly for men, is DI program participation. This point is further illustrated in Online Appendix G, where we show the relationships between class background nonemployment with and without disability insurance. For men, it is clear that both the changes in the overall level and in the social gradient of nonemployment (cf. Figure 3) is fully accounted for by nonemployment combined with disability insurance. For women, the picture is a bit more complicated as the trend in nonemployment for them also reflects the general rise in female labor force participation over the period in question. However, focusing on nonemployment in combination with disability insurance, the trends in the levels as well as in the social gradients are almost exactly the same for women and men, see Figure G.1 in Online Appendix G.

3.4. Family Formation

Figure 5 presents the development of the association between class background and the outcome of having found a life companion (being married and/or a parent) no later than age 40. Economic class may influence a person's attractiveness in the marriage market, and thus affect the probability of finding a mutually acceptable match. We identify a considerable class gradient in the probability of finding a partner for men (panel (a)), but not for women (panel (b)). This is in line with theories of hypergamy, suggesting that women on average give higher priority to a potential spouse's earnings capacity than do men (Hitsch, Hortaçsu, and Ariely 2010; Almås et al. 2019). In accordance with this theory, it is also clear that the marital class gradient for men has become steeper over time (panel (c)), in tandem with the gradients in economic outcomes. The correlation between economic class and partnering propensity has been relatively

FIGURE 4. (Continued) background by birth-year. Panels (g) and (h) show DI participation rates for the top and bottom class vigintiles relative the cohort average by birth-year. An "x" below two datapoints in panels (a)–(d) indicates that the difference between the two observations is not statistically significant at the 5% level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

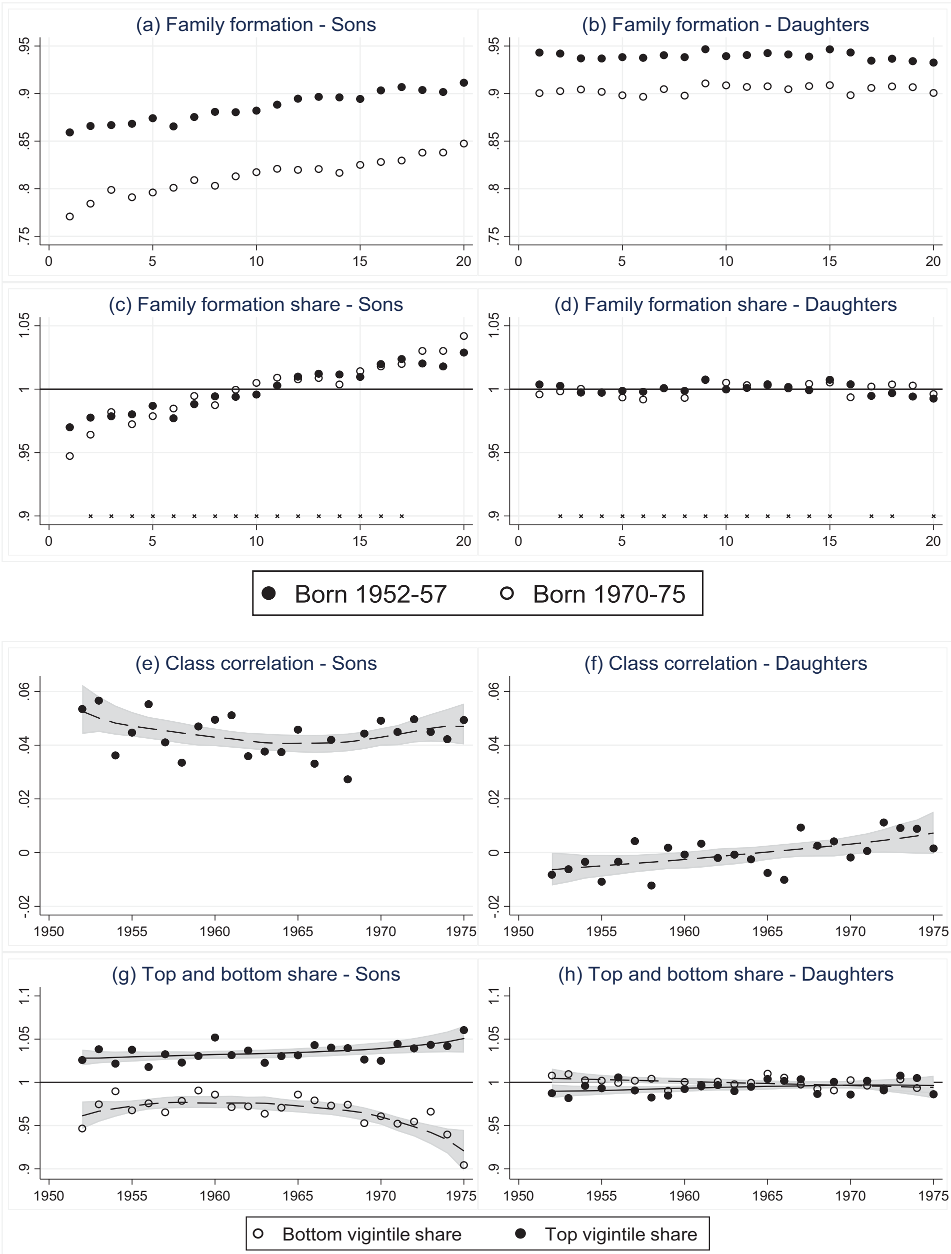

FIGURE 5. The probability of finding a partner by economic class and birth year. Finding a partner is a dichotomous variable set to unity if a person has (ever) married or obtained a child before the age of 40. Panels (a) and (b) show partnership rates by class background. Panels (c) and (d) show the partnership rates by class relative to the cohort's average. Panels (e) and (f) show the correlation between finding a partner and class background by birth-year. Panels (g) and (h) show partnership rates for the top and bottom class vigintiles relative the cohort average by birth-year. An "x" below two data-points in panels (a)–(d) indicates that the difference between the two observations is not

stable for both men (panel (e)) and women (panel (f)), however, and, as shown in panel (g), it is particularly at the bottom of the class distribution that we see considerable declines in men's chances of finding a partner. It also follows from Figure 5 that the overall matching frequency is higher for women than for men for all cohorts. The explanation for this is that much more men than women are "recirculated," in the sense that mate more than once before they reach the age of 40.

3.5. Net Household Income

Economic living standard is determined by all the outcomes considered so far. In addition, it is influenced by capital income, taxes, and transfers, and by household composition. Figure 6 presents the development of the association between class background and net-of-tax household income (adjusted by household size and composition) at age 40.[12] We have chosen age 40 as the age of measurement for this outcome for the reason that this is the only age at which the data allow us to collect this information for all the cohorts in our dataset.[13] By focusing at the household level, our examination of mobility patterns not only incorporates trends in marital prospects and the degree of assortative mating, but also changes in the division of labor within households. For example, one could hypothesize that the observed decline in relative earnings for the lower classes was offset by increased relative earnings among their spouses. For men, the rank–rank associations displayed in panel (a) are similar to those reported in Figure 2 for age 34–40 earnings rank. In particular, the lower classes have fallen considerably behind also in terms of consumption opportunities, although panel (c) shows that the distribution of net household income at age 40 is considerably more compressed across the social classes than the distribution of earnings age 34–40. We show in Online Appendix H that this is primarily related to taxes and transfers, and not to either the inclusion of the household dimension or the usage of only one income year. For women, it is clear that the association between class background and net household income has been much more stable than the association between class background and own earnings; confer. Figure 2. Hence, the decline in female economic mobility in terms of own labor market success has not in general implied an

FIGURE 5. (Continued) statistically significant at the 5% level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

12. For unmarried persons, we define a household as consisting of the person itself plus own children. For married persons, we define it as consisting of the person itself, his/her spouse plus own children plus partner's children (with someone else) divided by two. To adjust income for household size/composition, we use the EU equivalence scale, such that the person itself counts as 1, the partner 0.5, and each child 0.3.

13. The register data contain records on net income from 1993. This implies that all cohorts can be measured at age 40, except the very first one (1952), which is measured at age 41.

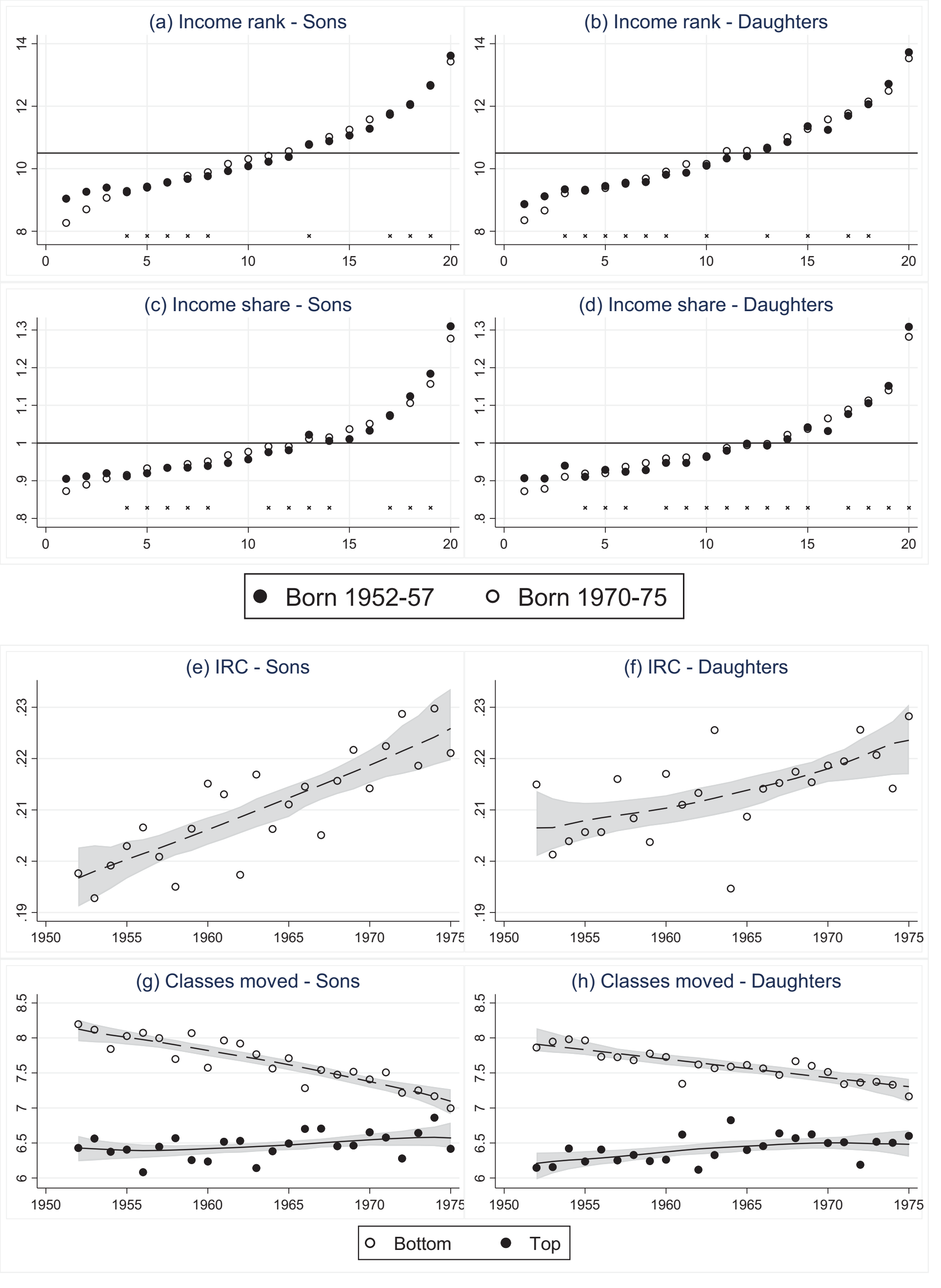

FIGURE 6. Indicators of net household income at age 40 by economic class and birth year. Net household income is total after-tax income for the household (including capital income and transfers), adjusted for household size (EU equivalence scale) and measured in the year of the reference person's 40th birthday. An "x" below two data-points in panels (a)–(d) indicates that the difference between the two observations is not statistically significant at the 5% level. The trend lines in panels (e)–(h)

equally large decline in the mobility of consumption opportunities. The bottom classes have fallen behind also in terms of net household income, however.

3.6. Mortality

The most fundamental quality-of-life indicator we can think of is being alive at all. A steep social gradient in longevity is an established fact (Marmot 2004), and recent evidence from the United States has indicated that differences in life expectancy across income groups have increased over time (Chetty, Hendren, and Katz 2016). However, this does not necessarily imply a larger impact of family background. To shed light on possible changes in the class gradient of mortality in Norway, we examine changes in the pattern of mortality by parental economic class. In our analysis so far, we have conditioned on survival (and residency in Norway) until age 40. To examine mortality as an outcome, we remove this condition, and add to the analysis population all native born Norwegians who died between the age of 18 and 40 (our data do not allow us to examine child mortality in a consistent way). We then recalculate the class ranking based on this extended population, and define death by age 40 as the outcome of interest. On average, around 2%–3% of the men and 1% of the women die between age 18 and 40. By examining mortality at such a low age, we of course lose many of the potentially most important sources of a class gradient in longevity, as mortality profiles at much higher ages will dominate this outcome. However, we may be able to encapsulate some class-related sources of early death, particularly those caused by risky behaviors.

The results are presented in Figure 7. Panels (a) and (b) confirm that there is a class gradient in mortality and also show that the gradient has become steeper for the later birth cohorts. This is further illustrated in panels (c) and (d), where we report each vigintile's mortality rate relative to the cohort's average. For both men and women, there has been a sharp increase in the relative mortality rates of the lowest class vigintiles. Panels (e) and (f) show the correlation between the mortality rate and class background cohort-by-cohort. The negative correlation is more pronounced for men than for women, and it has become a bit stronger over time. Finally, panels (g) and (h) show how the mortality rates have developed over time for the top and bottom vigintiles. For both men and women, there are signs of increasing disparities between offspring in the top and bottom vigintiles.

FIGURE 6. (Continued) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

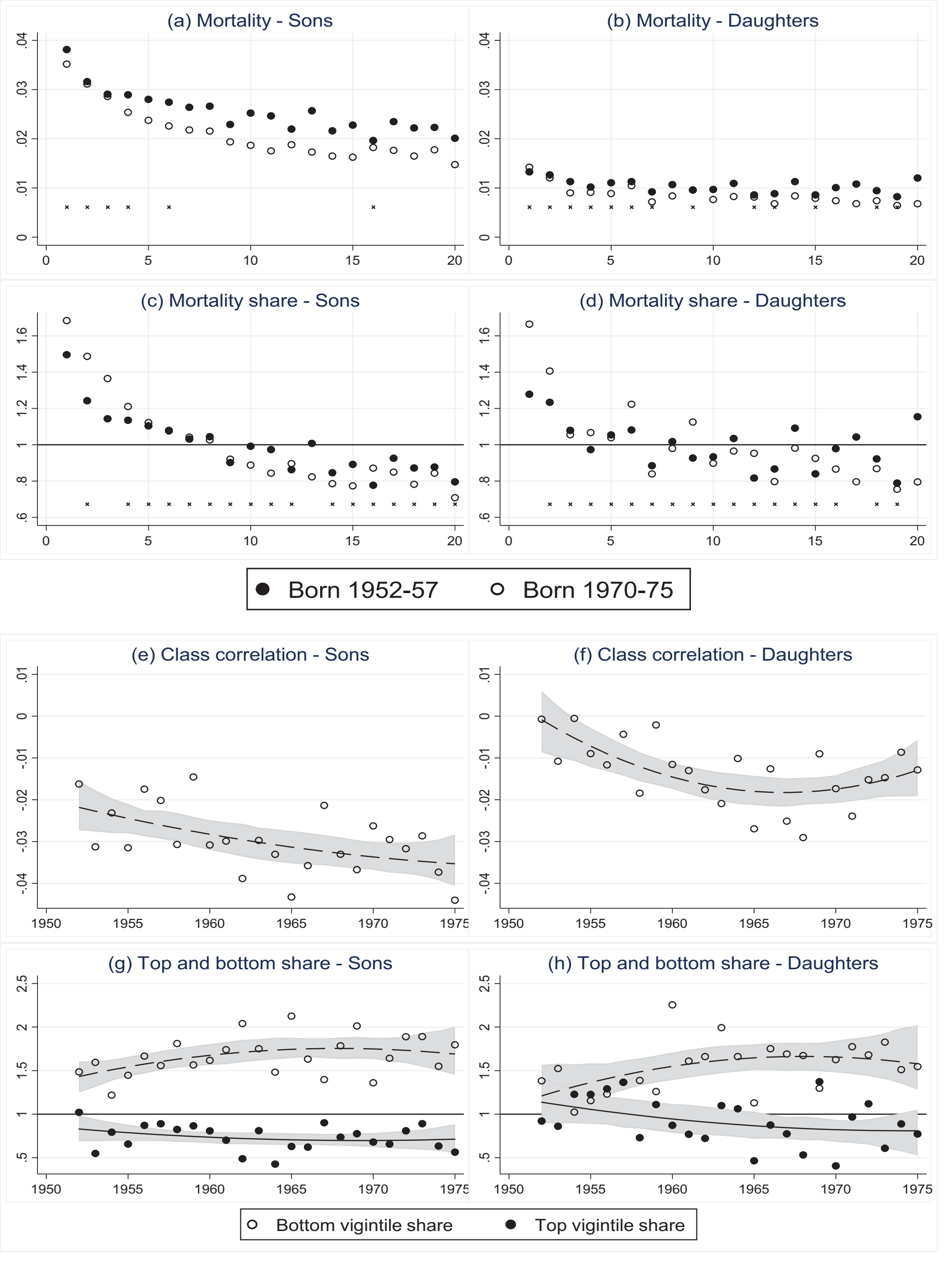

FIGURE 7. Mortality between age 18 and 40 by economic class and birth year. Mortality is a dichotomous variable set to unity if a person died between the age of 18 and 40. Panels (a) and (b) show mortality rates by class background. Panels (c) and (d) show the mortality rates by class relative to the cohort's average. Panels (e) and (f) show the correlation between mortality and class background by birth-year. Panels (g) and (h) show mortality rates for the top and bottom class vigintiles relative the cohort average by birth-year. An "x" below two data-points in panels (a)–(d) indicates that the difference between the two observations is not statistically significant at the 5%

3.7. Summing up

Considering all the outcomes examined in this section together, a main finding is that lower class sons have fallen consistently behind along several quality-of-life dimensions: Their upward earnings and income mobility has declined, both in terms of rank and share. Their relative employment rates have dropped sharply, accompanied by a rise in their relative exposure to disability insurance. Their relative chances of finding a life partner have declined. And finally, their relative mortality rates have increased. We identify similar developments for lower class daughters, with the exception that their chances of finding a life partner have not been reduced. For women, it appears that success in the marriage/mating market is independent of success in the labor market.

4. Mechanisms

The results we have presented so far suggest that there has been a general decline in economic mobility among daughters, and a particularly sharp decline in mobility for both sons and daughters born into the poorest families. From a policy perspective, it is of interest to know whether this development has arisen through changes in the distribution of human capital characteristics or through changes in the returns to those characteristics. Human capital endowments can again be divided into traits that are genetically inherited from parents (and thus largely beyond the influence of public policy) and qualifications that are (at least partly) obtained outside the household. This distinction is important, as a steeper social gradient in inherited human capital endowments signals a stronger association between ability and economic outcomes in the parent generation, which has then been carried over to the offspring through both the genetic and social transmission mechanisms. If this is the case, the falling-behind of the lower classes described in the previous section is essentially good news, as it reflects increasing equality of opportunities over the parent generations used to identify class background rather decreasing equality of opportunities over the offspring generations. Pekkarinen, Salvanes, and Sarvimäki (2017) present evidence indicating that economic mobility indeed increased substantially for cohorts born through the 1930s. As these cohorts represent the parent generations in our study, it appears probable that the declining mobility out of the bottom classes in the offspring generation is an artefact of an increasing correlation between economic outcomes and ability in the parent generations.

In this section, we first examine the trends in the associations between class background and inherited and noninherited human capital endowments. As we

FIGURE 7. (Continued) level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

explain in more detail in what follows, we use cognitive ability (IQ) test scores to proxy inherited endowments, whereas we use educational attainment to represent noninherited endowments. We then examine the trends in the economic returns to these traits. In the latter exercise, we focus exclusively on their influence on own age 34–40 earnings rank. Finally, we examine the extent to which the trends in the allocation of and the returns to human capital characteristics can explain the observed changes in the intergenerational earnings rank–rank associations, and discuss some possible causes.

4.1. The Class Gradient in Human Capital Endowments

Our examination of trends in inherited human capital characteristics is based on scores obtained in cognitive ability (IQ) tests administered by the armed forces since 1969/1970 to all men around age 18/19, whereas the analysis of noninherited human capital is based on educational attainment by age 40. We realize that the distinction between inherited and noninherited human capital is not perfect, as cognitive ability measured at age 18/19 has been shown to be somewhat affected by education (Brinch and Galloway 2012; Carlsson et al. 2015). However, based on existing data, the IQ test scores is arguably the best proxy we have for earnings related abilities that are inherited directly from the parents. Since the scores are available only for men, the analysis of the transmission of inherited human capital is limited to sons. There are some missing values also among men (10.0%), however, and when possible we use brothers' score to fill in for missing values (using the average brother score in cases of more than one brother). After having done that, the fraction of missing observations is reduced to 4.8%. Class rank assignment is in any case based on the complete dataset used in the previous section, including those for which we do not have an IQ score.

IQ test-takers receive an integer score running from 1 to 9, which is a composite of three tests, on arithmetic, word similarities and pattern recognition. Since the scale has been used slightly differently in different periods, we have sorted each birth cohort by IQ rank, and divided it into three equally sized groups, denoted low IQ, middle IQ, and high IQ, respectively. For each cohort, each ability group then encompasses exactly one third of the population. The division into three groups has been chosen for the reason that it, in contrast to more fine-grained divisions, can be made in a consistent fashion for all birth cohorts.[14] These IQ indicators are of course both imperfect and noisy measures of earning-related personal traits. However, as we show in what follows, they are highly correlated with economic outcomes, and may thus shed light on the potentially changing role that such traits may have played in accounting for intergenerational class persistence.

14. If there are multiple persons with equal IQ score around the thresholds that divide a cohort into the three equally large groups, we use random assignment to ensure the exact same distribution of the three IQ types for all cohorts. The random draws affect the IQ assignment for approximately 8%–10% of the sons in each birth cohort. To avoid undue influence from a single random draw, all the results involving IQ groups presented in this paper have been obtained by averaging over 120 draws.

Figure 8 shows how the distribution of cognitive ability across economic class backgrounds has developed over birth cohorts. Panels (a) and (b) first present each class vigintile's relative share of the low- and high IQ populations, respectively, for cohorts born in 1952–1957 and 1970–1975. It is clear that there is indeed a strong class gradient in cognitive ability. While the share of low IQ offspring in the bottom parental class vigintile is 50% higher than the average, its share of high IQ offspring is 50% lower. By contrast, the share of high IQ offspring in the top vigintile is 70%–90% higher than the average, whereas its share of low IQ offspring is 40%–50% lower. It is also clear that the class gradient in IQ has been relatively stable, with the exception that the top class' share of the high IQ group has declined whereas its share of the low IQ group has increased. Viewed as a whole, the trends in the relationships between class background and cognitive ability suggests that there has not been a systematic a drift toward meritocracy in the parent generations, as such a trend would most certainly have spilled over to the offspring generations in the form of a steeper class gradient.

To examine the evolvement of the class gradient in educational attainment, we first record for each offspring the number of noncompulsory education years (NCE) associated with the highest obtained education at age 40. These numbers are then used to examine the distribution across the social classes of the total number of education years allocated to each birth cohort. Figure 9 presents our findings. Again, we first compare the complete class distributions for the first six and the last six birth cohorts, before we present some summary statistics cohort-by-cohort. Panels (a) and (b) illustrate the large increases in the number of education years across the class distribution, particularly for daughters. For both men and women, the largest increases are observed for the middle classes, such that an originally convex relationship between class and education has become linearized. This becomes even more evident in panels (c) and (d) where we look at each class's average NCE relative to the whole cohort's average. It is then also clear that it is the lower middle classes that have raised their share of educational resources, whereas the upper classes have reduced their share. For men, we note that the very bottom class vigintile has roughly maintained its share. In a period with rapidly increasing educational attainment, this implies a larger education gap measured in absolute terms. While the average son (daughter) in the 1952–1957 cohort obtained 2.8 (2.4) years of noncompulsory education, the bottom vigintile obtained 1.9 (1.4) years. For the 1970–1975 cohorts, the corresponding numbers were 3.8 (4.3) and 2.5 (2.9). Hence, the bottom class's educational "deficit" increased from 0.9 to 1.3 years for men and from 1.0 to 1.4 years for women. Panels (e) and (f) show that the correlation coefficient between class background and years of education increased sharply for cohorts born in the 1950s and early 1960s, reflecting the linearization of this relationship. And panels (g) and (h) show that the declining share of education years allocated to the top class vigintile has been a trend throughout our data period. The bottom class share has been stable for men, whereas for women it has increased slightly for cohorts born after 1965.

As the economic impacts of educational attainment are unlikely to be linear, it is also of interest to examine how the social gradients in the achievement of critical educational levels have evolved. In Figure 10, we show for the first six and the last six

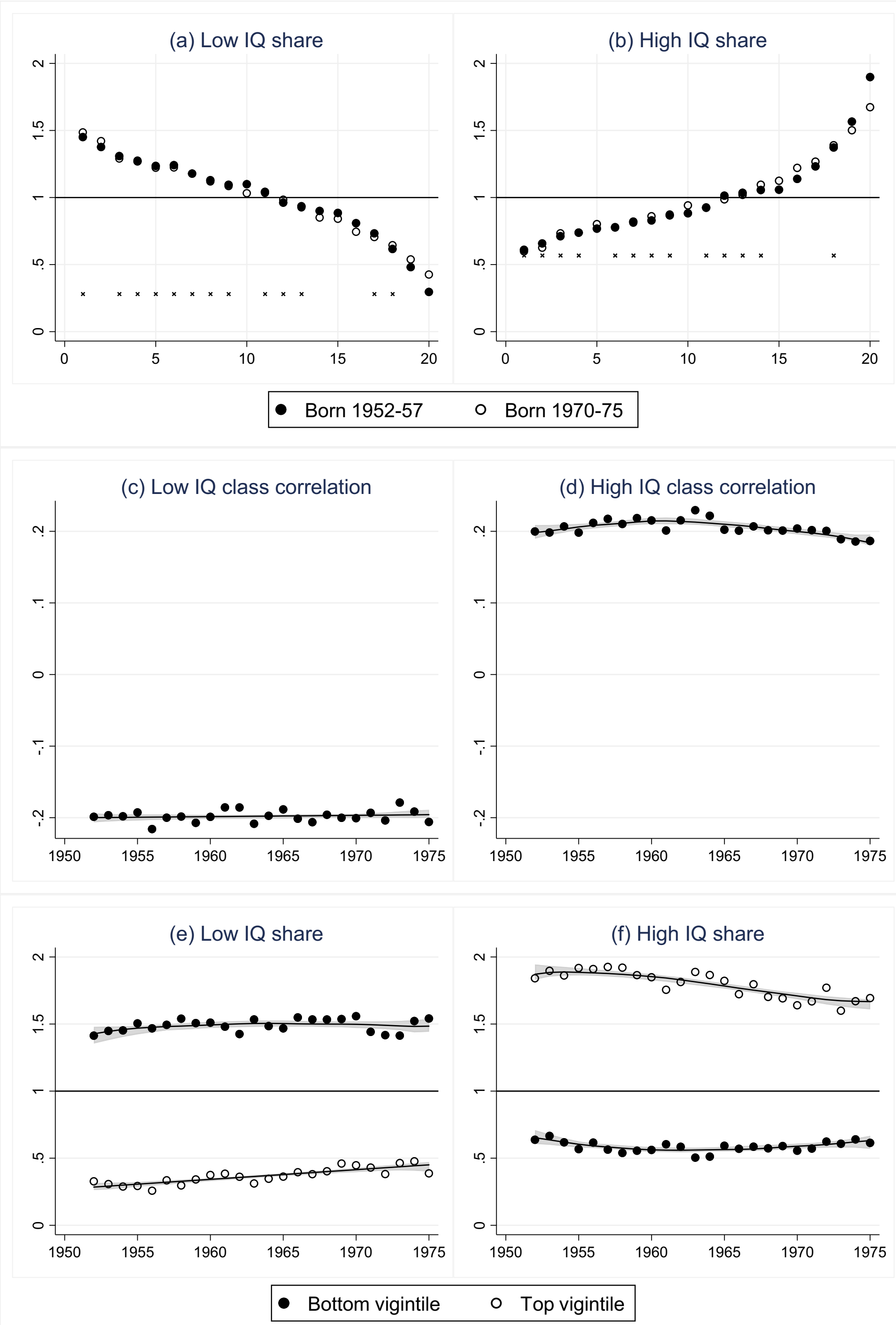

FIGURE 8. Cognitive ability by economic class and birth year (men only). Cognitive ability is measured at enrolment to compulsory military service around age 18–19, and classified as low,

cohorts the social gradients in the achievement of each of five attainment levels: (i) No high-school education, (ii) Some high-school education, (iii) High-school degree, (iv) Some college/university education, and (v) college/university degree. It is clear that there has been something like an educational revolution, with large increases in the shares obtaining high-school and college/university degrees. For the lower classes, we note, however, that the added education years primarily have been allocated to the completion of a high school degree as opposed to a partial high-school education. Moreover, although the fraction of persons with no high-school education at all has dropped considerably for almost all classes, it has remained almost unchanged at approximately one third for boys born into the bottom class; see panel (a).

4.2. The Returns to Human Capital

We now turn to an examination of trends in the way human capital endowments influence own earnings rank. If the returns to human capital have increased, this can potentially explain why the class gradient in economic outcomes has become steeper even in the absence of changes in the distribution of endowments. There is a large existing empirical literature discussing recent changes in the returns to skills that may point in that direction, see, for example, Acemoglu and Autor (2011). A typical view is that the demand for high skills outpaced the supply during the 1980s (Katz and Murphy 1992; Autor, Katz, and Kearney 2008), that there was polarizing decline in the demand for medium skilled labor continuing into the 1990s (Autor, Levy, and Murnane 2003; Goos, Manning, and Salomons 2014), and that the increasing demand for high skills may have gone into reverse after the turn of the century (Beaudry, Green, and Sand 2015).

We start out the assessment of trends in economic returns to human capital by examining the relationship between cognitive ability (IQ) and own earnings rank. To control for class background, we base our assessment on the following regression model:

$$y_{cti} = \delta_c + \sigma_t + \alpha_{ta} + \varepsilon_{i,} \qquad c = 1, \ldots, 20; \quad t = 1952, \ldots, 1975,$$
$$a = \text{medium IQ, high IQ,} \tag{1}$$

FIGURE 8. (Continued) middle, or high, with exactly one third of each cohort belonging to each group. Panels (a) and (b) show the shares of low and high ability offspring in each cohort accounted for by each class. Panels (c) and (d) show the correlation between class background and the likelihood of belonging to the groups of low and high ability, respectively. Panels (e) and (f) show the shares of low-ability and high-ability offspring in the bottom and top class vigintiles by birth-year. An "x" below two data-points in panels (a) and (b) indicates that the difference between the two observations is not statistically significant at the 5% level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

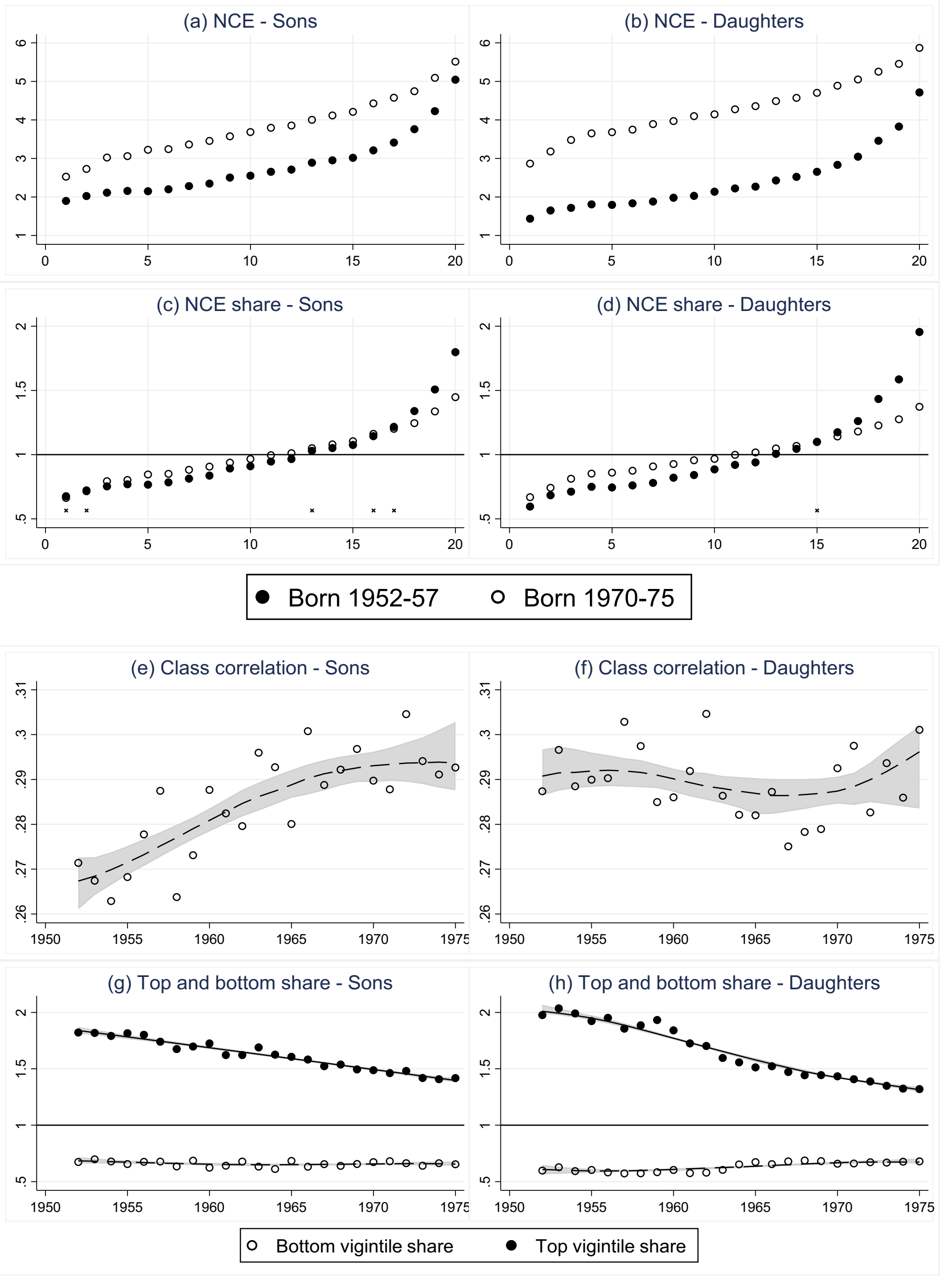

FIGURE 9. Years of noncompulsory education (NCE) by economic class. Offspring educational attainment is measured at age 40, and is recorded as the number of post-primary education years normally associated with the highest obtained education. Panels (a) and (b) show the average number obtained by each class, whereas panels (c) and (d) show these number relative to the cohort's average. Panels (e) and (f) display the correlation between NCE and class background for each birth cohort, whereas panels (g) and (h) show average NCE for the top and bottom class vigintiles relative the

where y_{cti} is the own earnings rank vigintile, δ_c is a parental class fixed effect, σ_t is a birth-cohort fixed effect (representing the time effects for a reference group of low-ability offspring), and α_{ta} is an ability-by-cohort fixed effect for the medium and high ability groups. We include daughters in this analysis provided that they have a scored brother, such that we can use the brother's IQ test score as a (noisy) proxy for the daughter's cognitive ability. This facilitates the inclusion of 59.6% of the daughters. The model is estimated separately for men and women, and the results are presented in Figure 11. A first point to note from this figure is that cognitive ability is indeed strongly associated with earnings rank outcomes. The high ability group performs much better than the middle ability group, which again performs much better than the low ability group (which is the reference group in the two panels). There is no unambiguous pattern of increasing influence of ability, however. To the contrary, for men, we note that the influence of cognitive ability on earnings rank has declined (panel (a)), and in particular that the high-ability premium has dropped considerably. Relative to the low-ability group, it has dropped from more than 4 vigintile ranks for the mid-1950s cohorts to around 3 ranks for the mid-1970s cohorts. For women, estimated returns are much smaller and the trends also less clear. However, this pattern may be an artefact of the much larger measurement error in female ability. In any case, it appears that we can reject the hypothesis that declining mobility out of the lower economic classes is a direct reflection of their higher share of offspring with low cognitive ability. Other things equal, the higher share of low-ability offspring in the lower classes has been a force for *increased* rank mobility.

Our finding of declining returns to cognitive ability in terms of earnings rank is in line with recent evidence indicating a shift in the demand for labor from cognitive to noncognitive skills (Castex and Dechter 2014; Deming 2017; Edin et al. 2017). Hence, while the intergenerational transmission of cognitive abilities may have been a force for increased economic mobility, it is probable that the transmission of noncognitive skills has worked in the opposite direction. Recent evidence from Sweden indicates that there is a considerable intergenerational correlation in noncognitive skills also (Grönqvist, Öckert, and Vlachos 2017), and together with the evidence pointing toward higher economic returns to noncognitive skills, this may have been a force for reduced mobility. As our data do not include any information about noncognitive skills, we cannot examine this hypothesis empirically. Recent evidence from Sweden (Grönqvist, Öckert, and Vlachos 2017; Edin et al. 2017) indicates, however, that the correlation between cognitive and noncognitive skills is high, and that the returns to noncognitive skills have increased most at the top of the earnings distribution. Hence, we find it

FIGURE 9. (Continued) overall cohort average by birth-year. An "x" below two data-points in panels (a)–(d) indicates that the difference between the two observations is not statistically significant at the 5% level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

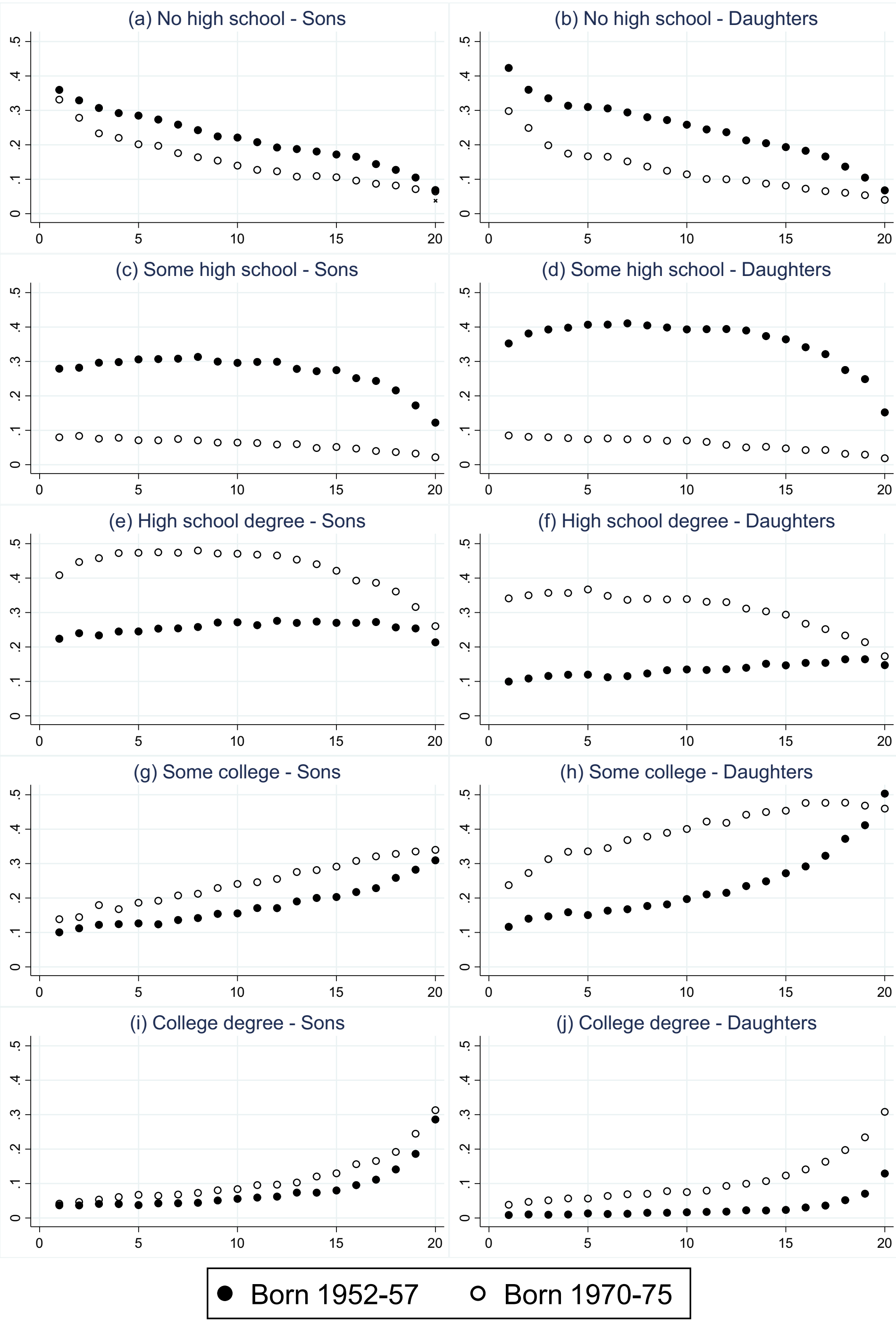

FIGURE 10. Educational attainment by economic class. The graphs show the fractions having obtained the indicated educations as their highest obtained educational level by age 40. An "x" below

unlikely that this is a main driver of the reduced mobility identified at the bottom of the parental class distribution.

In order to examine the trends in the returns to educational attainment, we add to the regression model interaction terms between birth cohort and educational attainment:

$$y_{cti} = \delta_c + \sigma_t + \alpha_{ta} + \beta_{te} + \varepsilon_{i,} \quad c = 1, \ldots, 20; \quad t = 1952, \ldots, 1975,$$
$$a = \text{medium IQ, high IQ,}$$
$$e = \text{some high-school, high-school degree, some coll./univ., coll./univ. degree,} \tag{2}$$

where β_{te} is the cohort specific returns to the different educational levels (with no post primary education at all as the reference category). Note that although we control for cognitive ability in our attempts to examine the returns to educational attainment in equation (2), we did not control for education when we examined the returns to ability in equation (1). The reason for this is that while a considerable part of the ability-effect is likely to go through educational attainment, the predetermined nature of cognitive ability implies (with some reservations) that we can rule out that the influence of education goes through cognitive ability.

Although we control for cognitive ability in equation (2), we emphasize that we cannot interpret the estimated effects as returns to education in a strictly causal sense, as we are not in possession of any instruments that can plausibly disentangle causality from selectivity. With this qualification in mind, we present the estimated rank returns to the different educational levels in Figure 12. They indicate increases in the returns to education starting with the cohorts born in the early 1960s. In particular, relative to not having any post-compulsory education at all, the values of obtaining a high-school or a college/university degree have risen considerably.

4.3. Why Have Lower Class Offspring Fallen Behind?

How much of the observed changes in the intergenerational rank–rank associations can the changes in human capital endowments and estimated returns explain? To answer this question, we use equations (1) and (2) to predict rank outcomes for everyone belonging to the first six and the last six birth cohorts in our dataset. To illustrate the explanatory power of each factor, we add explanatory variables in a step-wise fashion, and compare predicted with actually observed rank outcome changes by class vigintile. The results are presented in Figure 13. While the actual changes are marked with grey bars (repeated in each panel), the various predictions are marked with black dots and a

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FIGURE 10. (Continued) two data-points in panels (a)–(d) indicates that the difference between the two observations is not statistically significant at the 5% level. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

FIGURE 11. Trends in the estimated effect of IQ score on earnings rank. Reference is low IQ. By birth year. The graphs show the estimated returns to middle and high IQ by birth cohort, based on equation (1), with 95% confidence intervals. Daughters' IQ is proxied by the ability score test of brothers. Since this cannot be done for daughters without a brother, this reduces the sample by 40.4%. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

95% confidence interval. Note that the differences in earnings rank outcomes between early and late cohorts displayed in Figure 13 are not exactly equal to those that come out of a comparison of the same cohorts in Figure 2, panels (a) and (b). The reason for that is that observations with missing data on IQ have been dropped.

Panels (a) and (b) first report the predicted impact of the observed changes in the distribution of cognitive ability endowments across classes, given the initial levels of returns to ability. The predictions in these panels are based on equation (1), but used such that the returns to ability is held fixed at the 1952 level (i.e., with α_{ta} fixed at α_{1952a}). It is clear that we cannot explain much of the observed rank-reallocations by redistribution of ability across classes, except for men at the very top of the class distribution. When we incorporate the estimated cohort-specific returns to cognitive ability from equation (1) in panels (c) and (d), we explain even less of the observed decline of the lower classes, but all of the decline at the top for men. Focusing on the bottom classes, it is notable that the decline in the returns to cognitive ability shown in

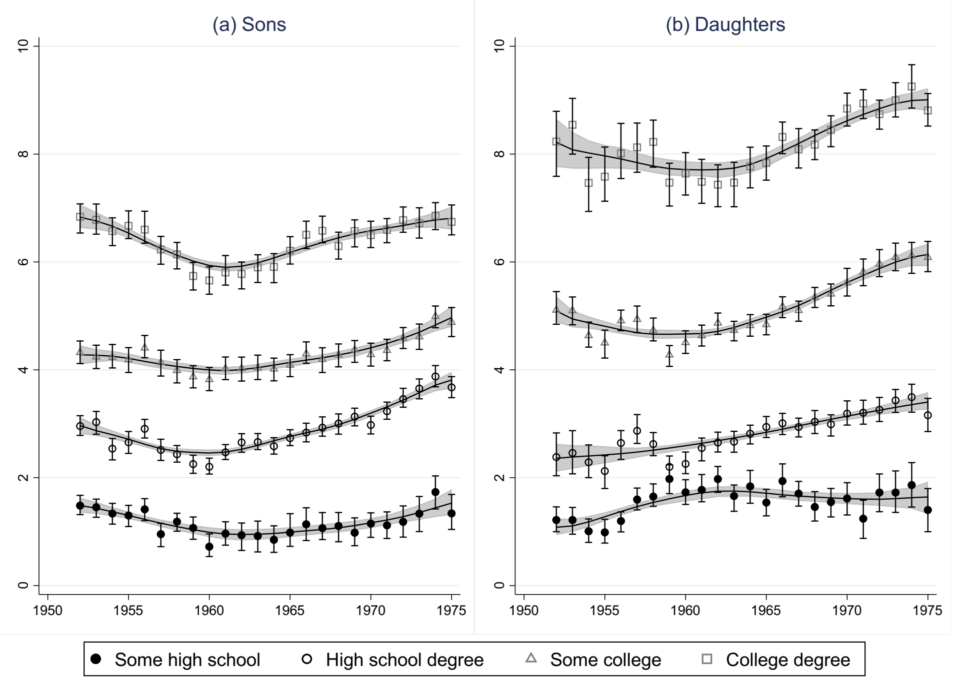

FIGURE 12. Trends in the estimated effect of educational attainment on earnings rank. Reference is compulsory education only. By birth year. The graphs show the estimated returns to educational attainments level higher than compulsory education, based on equation (2), with 95% confidence intervals. The trend lines in panels (e)–(h) are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials. See also note to Figure 11.

Figure 11 has constituted a force for larger upward rank mobility, as the lower fraction of high-ability offspring in the lower classes has become less important.

In panels (e) and (f) we add into the model the observed changes in the classes' educational attainment, assuming time-invariant returns to education. The predictions in these panels are thus based on a version of equation (2) with fixed returns to education at the 1952 levels (i.e., with β_{te} fixed at β_{1952e}). The predictions show that changes in the distribution of educational attainment across classes can indeed explain parts of the lower classes' decline, whereas they "over-explain" the drop at the very top, for both men and women. Although we have seen that educational attainment has increased for all classes, it is thus clear that the bottom classes have fallen behind in terms of educational resources important for economic performance.

In panels (g) and (h) we report the predictions from the full model in equation (2), incorporating the changes in the returns to education shown in Figure 12. Based on this model, we can explain a considerable part of the lower classes decline, as well as much of the rise of the middle classes. Viewed as a whole, it appears that the changes

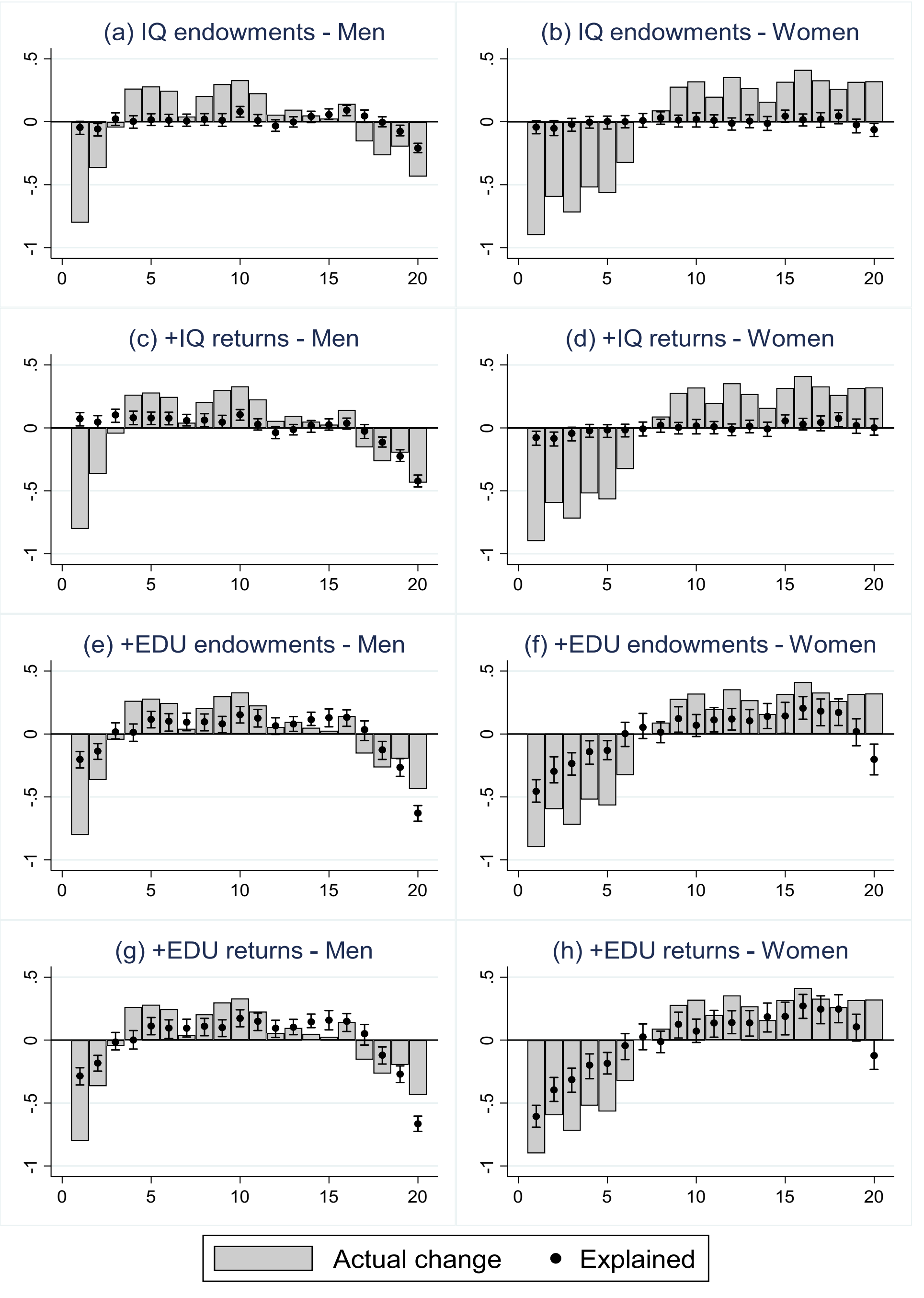

FIGURE 13. Explained and unexplained changes in the intergenerational rank–rank mobility. All panels show the difference in average rank outcomes between the 1952–1957 and the 1970–1975 birth cohorts, by class background. Panels (a) and (b) also show the predicted changes from equation (1), with the returns to ability fixed at the 1952 level (with 95% confidence intervals). Panels (c)

in observed human capital endowments and in their estimated returns do explain a substantial part of the observed changes in earnings rank outcomes across the different classes.

Our findings suggest that while the educational "revolution" has contributed to lifting the middle classes relative to the bottom classes, it has not improved the relative position of the lower classes. To the contrary, as the bottom classes have not taken fully part in the educational upgrading, they have lost out both due to lower relative educational attainment and due to the rise in the economic returns to education.

An important question then is why have the lower classes not taken advantage of improved educational opportunities to the same extent as the middle classes? After all, most educational tracks are free of charge in Norway, and educational slots are allocated on the basis of objective past performance criteria, not on the basis of willingness to pay or access to influential networks. Moreover, we have also seen a considerable equalization of educational attainment across ability groups, which, given the distribution of ability across classes (cf. Figure 8), should have represented a powerful force for equalization also across classes. The latter is illustrated in Figure 14, where we show how the average number of noncompulsory education years have developed over time by ability group.

Why, then, are the lower classes (still) lagging behind in terms of educational attainment? A possible answer to this question is that family support and encouragement are important inputs to educational achievement, and that such support and encouragement—in line with existing evidence (Guryan, Hurst, and Kearney 2008; Kalil, Ryan, and Corey 2012; Mayer et al. 2015)—are provided less by lower class families. To illustrate the empirical consequences of a class gradient in educational support, assume that educational attainment is determined by a combination of family support, cognitive ability, and other factors that are unrelated to class and ability (preferences). Then, conditional on other factors, the ability threshold associated with each level of educational attainment is a decreasing function of family support, and thus of class. This has the implication that the within-class distribution of educational attainment is more skewed toward high ability offspring the lower is the economic class. And this is indeed exactly what we see in the data. We illustrate this in Figure 15, by showing for each class and for two different time periods the share of offspring with secondary or tertiary education (NCE > 0) among those with high

FIGURE 13. (Continued) and (d) show the predicted changes from equation (1), allowing for time varying returns to ability. Panels (e) and (f) show the predicted changes from equation (2), with the returns to education fixed at the 1952 level. Panels (g) and (h) show the predicted changes from equation (2), allowing for time varying returns to both ability and education. To avoid disturbances from missing observations (due to missing IQ data), and to ensure that the predicted rank distributions are constant over time (also in the counterfactual case with constant returns and rising educational attainment) both observed and predicted rank changes are scaled such that the average change is zero. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

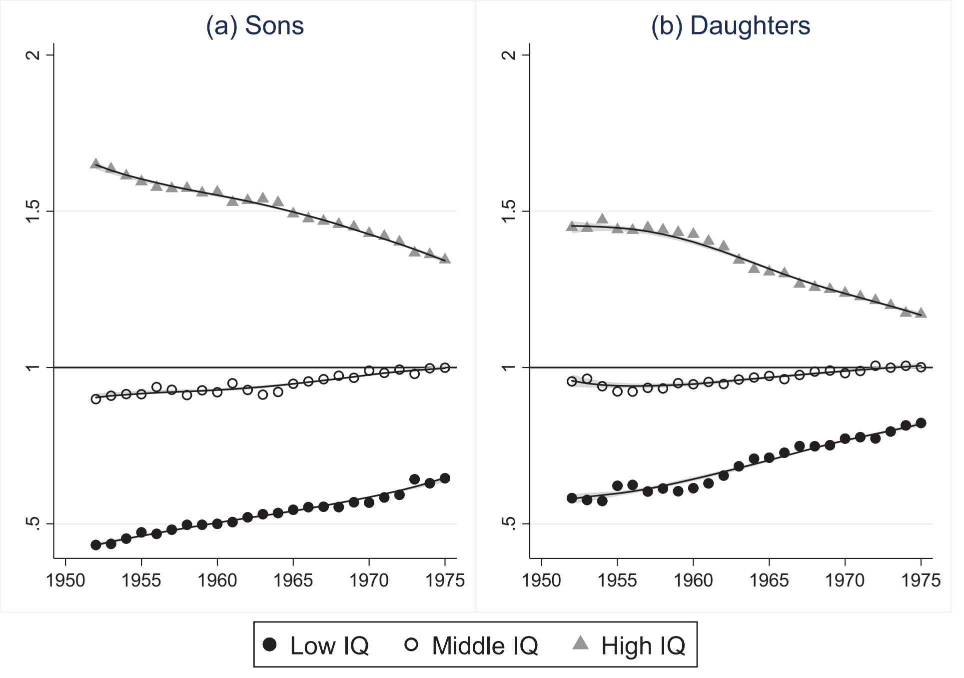

FIGURE 14. Education share (years of NCE relative to cohort average) by cognitive ability. Cognitive ability for daughters is proxied by brother's average test score. Panel (b) is therefore based on a reduced dataset comprising daughters with brothers only (65% of the population). The trend lines are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

ability relative to those with low ability. The figure highlights two points. The first is the strong and rather monotonous social gradient in the ability level among those with secondary/tertiary education. For example, while the probability of having at least secondary education is quite similar for high-ability and low-ability offspring within the upper classes (10%–20% higher for those with high ability), the relative difference is considerably larger within the lower classes (65%–80% for sons and 35%–70% for daughters). And although the ability-differential has declined sharply over time, particularly within the middle classes, it is still large at the bottom of the class distribution.

Although the trends in the distribution of, and the returns to, human capital endowments can account for parts of the observed changes in earnings rank mobility, most of the changes remain unexplained. This is likely to reflect measurement error in human capital variables, particularly in cognitive ability, as well as the influence of other factors, such as social skills and class-biased labor demand changes due to changes in technology, industry composition, trade patterns, or immigration.

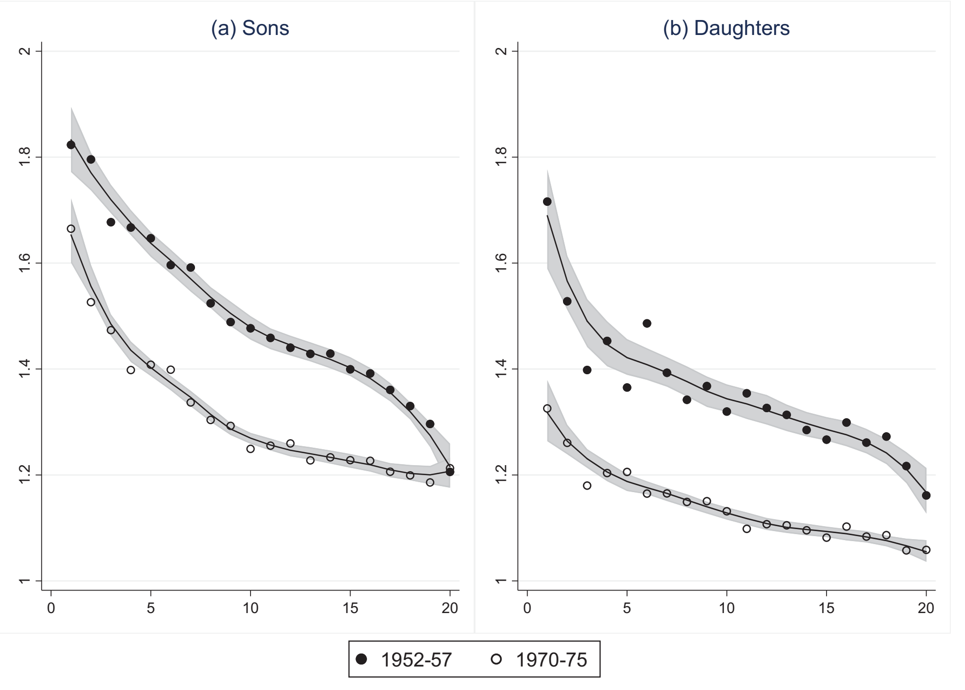

FIGURE 15. The overrepresentation of high-ability offspring in education. By birth cohort and class. The data points show for each class and cohort the share of offspring with secondary or tertiary education among those with high ability relative to those with low ability. The trend lines are estimated with local polynomial (second order) regressions, and the shaded areas mark the 95% point-wise confidence interval for the location of these lines. Statistical uncertainty is evaluated by means of a nonparametric bootstrap with 120 trials.

5. Concluding Remarks

In this paper, we have examined the trends in intergenerational mobility among Norwegian offspring born between 1952 and 1975. While rank–rank earnings mobility has declined considerably for daughters, it has remained stable or declined moderately for sons. The most conspicuous development, however, is that offspring born into the lowest decile of the parental earnings rank distribution have fallen considerably behind along all quality-of-life outcome dimensions studied in this paper, that is, not only earnings, but also employment, net household income, health (as measured by disability program participation), family formation (for men), and mortality.

We have examined the empirical support for four different explanations behind the relative decline of the lower classes. The first is that the apparently declining mobility in the offspring generation is simply an artefact of higher mobility in the parent generation. The idea behind this hypothesis is that a transition toward meritocracy in the parent generation resulted in a stronger association between ability and earnings among parents, which was then carried over to the offspring generation through the genetic transmission mechanism. The evidence presented in this paper does not support this hypothesis, as the class gradient in cognitive ability (IQ) has remained stable. In particular, lower class offspring have not become systematically more adversely selected in terms of ability.

The second hypothesis is that the economic returns to cognitive ability have increased, for example, due to skill-biased technical change or increased low-skill competition from international trade. Since offspring with low cognitive ability have been overrepresented in low class families throughout our data period, such a development could clearly have reduced the relative earnings prospects for low class offspring, even though it has nothing to do with class per se. However, the evidence does not support this hypothesis either. Low-ability offspring have *not* been left behind more generally. To the contrary, we show that low-ability offspring on average have improved their earnings rank, most likely as a result of increased educational opportunities. As the limited postcompulsory educational capacity available for the cohorts born in the early 1950s to a large extent was occupied by the high ability group, the subsequent expansion of the capacity has almost exclusively benefited the groups with low and middle IQ.

The third hypothesis is that lower class offspring have been left behind in the educational revolution; that is, that they have not taken full advantage of the new educational opportunities in line with other offspring. The evidence suggests that there is some truth to this hypothesis. Although the education levels of lower class offspring have not systematically declined relative to the cohort averages, they have not risen either, despite that they were at the bottom of the education ladder to start with, and despite the lower classes' larger share of low-ability offspring. In absolute terms, the difference in the number of education years between the lower classes and the cohort averages has increased by approximately half a year from the early 1950 s cohorts to the early 1970 s cohorts.

Finally, the fourth hypothesis is that the earnings rank returns to education have increased. This implies that a given class gradient in educational attainment is translated into a gradually steeper class gradient in earnings rank. This hypothesis is clearly supported by our data. In particular, we find that the returns to high-school and college degrees has increased sharply for cohorts born after 1960. Yet, even when we account for both the observed changes in the distribution of education and the changes in its returns, we can only explain a modest share of the overall observed changes in mobility.

The evidence presented in this paper suggests that the expansion of educational opportunities has been a double-edged sword in terms of its impact on class mobility. On the one hand, it has substituted for largely inherited cognitive ability, and thus made own economic fortune less dependent on the genetic transmission mechanism. On the other hand, it has rendered educational achievement a more critical ingredient of economic success, and thus potentially made own economic fortune more dependent on educational encouragement and support from the family. Our findings suggest that the resultant rising role of the social transmission mechanism has dominated the declining role of the genetic transmission mechanism at the bottom of the class distribution in Norway, and consequently augmented the handicap of being born into a low class family. This finding points to a genuine challenge with respect to the aim of ensuring equality of opportunities in the knowledge economy. As educational achievement becomes a more critical ingredient of economic success and other quality-of-life outcomes, the central role that family background plays during the formative years of education is likely to become more important. Ceteris paribus, this will represent a force for declining social and economic mobility at the bottom of the class distribution.

Based on the findings reported in this paper, we may suspect that standard measures of intergenerational mobility, particularly those measuring offspring earnings at early stages of the lifecycle, have failed to pick up trends toward lower rank mobility also in other countries. In particular, they may have missed what has been going on at the very bottom of the parental earnings rank distribution. Although we need to be careful generalizing all our findings to other countries, it is difficult to see why the trends identified in this paper should be specific to Norway. After all, Norway is a country characterized by a large and ambitious welfare state explicitly designed to ensure equality of opportunities; hence, when the bottom is falling behind in this country, this may not bode well for countries with less ambitious social and educational policies.

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Supplementary Data

Supplementary data are available at *JEEA* online.