DISCUSSION PAPER SERIES

IZA DP No. 9752

The Evolution of Social Mobility: Norway over the 20th Century

Tuomas Pekkarinen
Kjell G. Salvanes
Matti Sarvimäki

February 2016

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

The Evolution of Social Mobility: Norway over the 20th Century

Tuomas Pekkarinen
VATT, Aalto University and IZA

Kjell G. Salvanes
Norwegian School of Economics and IZA

Matti Sarvimäki
Aalto University and VATT

Discussion Paper No. 9752
February 2016

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 9752
February 2016

ABSTRACT

The Evolution of Social Mobility: Norway over the 20th Century*

This paper documents trends in social mobility in Norway starting from fathers born at the turn of the 20th century and ending with sons born in the 1970s. We measure social mobility with intergenerational income elasticities, associations between fathers' and sons' income percentiles, and brother correlations. All approaches suggest that social mobility increased substantially between cohorts born in the early 1930s and the early 1940s. Father-son associations remained stable for cohorts born after WWII, while brother correlations continued to decline. The relationship between fathers' and sons' income percentile ranks is highly nonlinear for the early cohorts, but approaches linearity over time. We discuss increasing educational attainment among low- and middle-income families as a possible mechanism behind these trends.

JEL Classification: I24, J08

Keywords: intergenerational mobility, education, sibling correlation

Corresponding author:

Tuomas Pekkarinen
Government Institute for Economic Research (VATT)
Arkadiankatu 7
P.O.Box 1279
00101 Helsinki
Finland
E-mail: tuomas.pekkarinen@vatt.fi

* We thank the editor, two anonymous referees and the seminar participants at EALE, FEA, HECER, NHH, SOLE and Conference on Social Mobility at the University of Chicago for insightful comments and suggestions, and the Academy of Finland and the Norwegian Research Council for funding.

1 Introduction

The debate on the consequences of income inequality has drawn attention to the cross-country differences in social mobility. A large body of research has shown that countries that are known for redistributive welfare state institutions and low cross-sectional income inequality, such as the Nordic countries, have much lower degree of intergenerational income persistence than, for example, the United States or United Kingdom.[1] These cross-country differences have led to speculation about their potential causes and implications. Yet, it is difficult to draw conclusions from a pattern present in one point in time. As a response, research has recently shifted towards a complementary approach of documenting within-country changes in social mobility.

In this paper, we examine the evolution of social mobility in Norway for children born between early 1930s and mid 1970s using newly digitalized data and alternative measurement approaches. These birth cohorts are of particular interest because they cover the period in which the Norwegian economy went through a dramatic structural change and much of the Norwegian welfare state was built. The last cohorts included in our data were born into one of the world's richest countries with extensive redistributive institutions and a high level of intergenerational mobility. In contrast, our earliest birth cohorts grew up in a relatively poor and unequal country. We show that they also experienced less social mobility than the later birth cohorts.

We contribute to the earlier literature in several dimension. We use high-quality register data augmented with military records from the early 1950s and newly digitalized municipal tax records from 1948. These data allow us to present precise estimates for cohorts born before WWII. Moreover, we use three different measurement approaches—intergenerational income elasticities, associations between father's and son's income percentile ranks, and brother correlations—in order to assess the robustness of the patterns over time. We also examine the non-linearities in the father-son associations and, in particular, document changes in these non-linearities across birth cohorts. Finally, we document the changes in the association between educational attainment and family background.

Our paper adds to the growing literature on the historical trends in intergenerational mobility. Previous work examining Nordic countries include Pekkala and Lucas (2007)

[1] See Black and Devereux (2011) and Corak (2013) for recent surveys.

who document trends in intergenerational income elasticity in Finland, and Björklund, Jäntti, and Lindquist (2009) who examine the evolution of brother income correlations in Sweden. Both of these papers present evidence on increasing mobility between cohorts born in the 1930s and 1950s, and stable or decreasing social mobility for the later birth cohorts. Modalsli (2015) documents a substantial increase in intergenerational occupational mobility in Norway between 1865 and 2011. In contrast, Lindahl, Palme, Sandgren Massih, and Sjögren (2015) focus on the descendants of one generation of school children in one Swedish city and find no evidence of changes in intergenerational income mobility. Clark (2012) examines the persistence of surnames among elite occupations and argues that rates of social mobility in Sweden have remained roughly stable since the pre-industrial era. Finally, and in line with our results, Bratberg, Nilsen, and Vaage (2005) find that intergenerational income elasticities among the post-WWII cohorts in Norway remained stable.[2]

Our main findings are as follows. All three approaches suggest that social mobility increased between cohorts born in the early 1930s and the early 1940s. For the cohorts born after WWII, our findings are more mixed with father-son income associations remaining stable, while brother correlations continue to decline. A closer examination of the joint father-son income percentile distribution reveals a fairly complex evolution. Downward mobility among the sons of the highest earning fathers became more common over time, while upward mobility from the 25th percentile of fathers' income distribution steadily increased. The prospects of sons of the lowest-earning fathers first improved and then deteriorated. We find no changes for sons of fathers between the 50th and 75th percentiles of the income distribution.

Guided by theoretical work starting with Becker and Tomes (1979) and extended, among others, by Solon (2004), Hassler, Mora, and Zeira (2007), and Ichino, Karabarbounis, and Moretti (2011), we augment our analysis by documenting trends in returns to education and in association between family background and educational attainment. We show that among the cohorts for whom social mobility increased, educational attain-

[2]Studies examining trends in social mobility outside of the Nordic countries include Aaronson and Mazumder (2008), Lee and Solon (2009), Chetty, Hendren, Kline, Saez, and Turner (2014), Olivetti, Paserman, and Salisbury (2013), and Olivetti and Paserman (2015) for the United States; Blanden, Goodman, Gregg, and Machin (2011) and Nicoletti and Ermisch (2008) for the United Kingdom; and Lefranc and Trannoy (2005) for France. Long and Ferrie (2013) is a comparison of historical changes in mobility in the U.S and U.K.

ment increased rapidly among sons of fathers below the 80th percentile of father income distribution. At the same time, returns to education decreased. This pattern is consistent with a hypothesis that the major educational reforms initiated in the 1930s substantially improved educational opportunities with the exception of the sons of the highest-earning fathers (who were already being highly educated). The resulting increase in the supply of educated workers may then have decreased returns to education. While our analysis is purely descriptive, these stylized facts allow us to build a consistent narrative. We leave a more rigorous testing of this narrative for future research.

The rest of the paper is structured as follows. In the following section, we briefly discuss the changes in the institutional context in Norway during our period of study. The third section reviews the estimation methods used for assessing social mobility. In the fourth section, we explain how we combine information from Norwegian censuses, military records, tax register and municipality-level tax records to construct our data.We present the main results on changes in intergenerational mobility over time in section 5 and discuss the role of education in section 6. The final section concludes.

2 Institutional context

In 1930, Norway was a poor and relatively unequal country in current standards with a GDP per capita at around $4,000 in 2002 U.S. dollars, top one percent income share at 13% and a population with an average of seven years of education. On the other hand, the standard of living in Norway was comparable to that of Sweden and the UK at the time as measured by GDP per capita, average years of education, average height, life expectancy and infant mortality.[3]

During the next few decades, Norway went through a dramatic transformation. The economy industrialized rapidly and grew fast from mid-1930s onwards. During this period—and particularly after WWII—Norway, like other Nordic countries, introduced extensive welfare institutions that provide public services and insurance to everyone for free or at a highly subsidized price. An important political shift took place in 1935, when the Labour party came into power and started to extend old age pension, disability pension, sickness leave, and unemployment benefits to cover the entire country and all

[3]The figures used in this section come from Grytten (2004, 2014), Aaberge and Atkinson (2010), Statistics Norway (1995) and the "Clio Infra" website (https://www.clio-infra.eu/datasets/).

industries.[4]

One of the first initiatives of the Labor Government was to reform the education system with the aim of providing similar educational opportunities for all Norwegians. The background of this reform was the large regional differences in the supply of education. For example, the actual amount of teaching provided per year varied between 42 weeks in cities to as low as 12 weeks in some rural municipalities. The reform was rolled out over the next decade and led to a major increase in the public spending on education. Another major educational reform took place in the 1960s when the mandatory education was extended from seven to nine years. Furthermore, the high school sector and regional college and university sector was expanded, particularly from the early 1970s onwards.

However, the transformation to a fully developed welfare state was not immediate, and it partly relied on local initiatives by municipalities or private initiatives by philanthropic societies. For example, school breakfast programs were initiated by some municipalities from the mid 1930s onwards (Bütikofer, Mølland, & Salvanes, 2016). Another example is the well-child visit centers for mothers and new born children, which were introduced by a philanthropic society in the 1930s and taken over by the state only in the early 1970s (Bütikofer, Løken, & Salvanes, 2016). Family polices like maternity leave and subsidized day care were launched in the mid-1970s and implemented gradually (Carneiro, Løken, & Salvanes, 2015). Furthermore, a fully developed social security system was introduced in the mid 1960s.

In short, the cohorts born in the 1970s grew up in a very different country than those born in the 1930s. By 1990, Norway had become one of the richest and equal countries in the world with a GDP per capita over $20,000 in 2002 U.S. dollars and a top income share of 4%. While 40% of the population still had only mandatory schooling, 15% had a university degree.[5]

[4]Partial versions of these programs had been introduced earlier in some municipalities and occupations/industries. The implementation of these reforms was interrupted by the WWII and the German invasion, but continued after the war.

[5]As we discuss in Section 6, the last birth cohort we examine—who were teenagers in 1990—ended up having much higher educational attainment than the 1990 population.

3 Measurement

Estimation of intergenerational mobility has a long history and the econometric and measurement issues have been extensively discussed in numerous surveys.[6] We examine several measures of mobility—intergenerational income elasticity, rank-rank slopes, expected percentile ranks, and the sibling correlation of income—and focus on their changes over time. These measures provide alternative and complementary perspectives on intergenerational income persistence. In this section, we briefly discuss the estimation and interpretation of each measurement approach.

3.1 Intergenerational Income Elasticity

The most common measure of social mobility is the intergenerational income elasticity, which is typically measured by estimating the regression

$$\ln Y_i = \alpha + \beta \ln X_i + \epsilon_i \tag{1}$$

where Y_i is a measure of the sons' income and X_i is a measure of his father's income.

The intergenerational elasticity, β, can change over time for several reasons. First, it can reflect changes in both the intergenerational correlation between fathers' and sons' income and changes in cross-sectional income inequality. To see this, note that

$$\beta = \frac{\sigma_y}{\sigma_x}\rho \tag{2}$$

where ρ is the intergenerational income correlation and σ_y and σ_x are the standard deviations of sons' and fathers' log income, respectively. Thus a decrease in β can follow from both a decrease in intergenerational correlation or a decrease in cross-sectional income inequality.

An important practical challenge in interpreting and estimating the intergenerational income elasticity is that the association between fathers' and sons' log income tends to be highly nonlinear (Bratsberg et al., 2007; Chetty, Hendren, Kline, & Saez, 2014). As a consequence, the estimates for β can be highly sensitive to whether the tails of fathers' income distribution are included in the estimations. In Figure A1 in the online Appendix,

[6] See for example Solon (1999), Björklund and Jäntti (2009), Black and Devereux (2011), and Jäntti and Jenkins (2013).

we show that strong nonlinearities are present also in our data. Thus, changes in the tails of fathers' income distribution may have disproportionate influence on the changes in β. In order to examine whether this issue affects our conclusions, we report estimates below using our full data and a restricted sample, where we omit the top and the bottom deciles of the fathers' income distribution. We also investigate nonlinearities in detail in the context of income percentile ranks.

3.2 Rank-rank Slope and Expected Percentile Ranks

Recent work on social mobility has shifted away from intergenerational income elasticities and towards the association between fathers' and sons' income percentile ranks. This approach has several advantages (Chetty, Hendren, Kline, & Saez, 2014). First, intergenerational income elasticity estimates tend to suffer from important attenuation and lifecycle biases, when one is forced to use snapshots of income data to construct proxies for lifetime income (Haider & Solon, 2006; Böhlmark & Lindquist, 2006; Bhuller, Mogstad, & Salvanes, in press). In contrast, Nybom and Stuhler (2014) show that estimates for income percentile ranks are not sensitive to the age of measuring son's income as long as it is measured at their mid-30s to late-40s. Second, percentile ranks provide a natural way to deal with zero incomes, which create an important measurement challenge when measuring income in logarithms (Solon, 1992).

We start examining the association between fathers' and sons' income percentile ranks by estimating the regression

$$P_i = \alpha + \beta R_i + \epsilon_i \tag{3}$$

where P_i is son's percentile rank in the income distribution of his birth cohort and R_i is the percentile rank of his father. In regression (3), α corresponds to the expected income percentile of a son of the poorest father and the "rank-rank slope" β measures the difference in the expected percentile of the offspring of the poorest and the richest fathers. Thus, β is a measure of relative income mobility.

An alternative approach is to examine the expected percentile rank of a son with a father at the r^{th} percentile. For example, Chetty, Hendren, Kline, and Saez (2014) use the expected percentile rank of children whose parents are at the 25th percentile, $\hat{\alpha} + .25\hat{\beta}$, as

a measure of "absolute upward mobility". We extend their approach in two ways. First, we report the expected percentile rank of sons over the entire distribution of fathers' income distribution and focus on the changes in these expected percentile ranks over time. Second, we use local linear estimators to take into account that the association between fathers' and sons' income percentile ranks is not linear in our data. This analysis allows us to pin down where in fathers' income distribution changes in mobility took place, and whether the importance of particular parts of the parental income distribution changed over time.

3.3 Brother Correlations

An alternative way to measure social mobility is to examine brother correlations instead of father-son associations. An advantage of this approach is that one does not need to observe parental income in order to calculate the correlation in income between brothers. A conceptual advantage is that since brothers share the growth environment in a more general sense, brother correlation can be interpreted as a broader measure of the importance of childhood conditions than intergenerational associations. Thus, comparison of trends in intergenerational associations and siblings correlations may be informative about the changes in the importance of the factors that are shared by brothers—such as school quality or changes in the importance of residential neighborhood—but not fully captured by their fathers' income.

We follow the estimation approach by Björklund et al. (2009) and regress the log income of each brother i in family j at time t, Y_{ijt}, on year and age dummies Z_{ijt}

$$Y_{ijt} = \gamma Z_{ijt} + \epsilon_{ijt} \tag{4}$$

The error term, ϵ_{ijt}, is modeled to consist of the permanent family component shared by all the brothers in a family, a_j, the permanent component that is specific to individual, b_{ij}, and an error term that picks up deviations from lifetime income, v_{ijt}, so that $\epsilon_{ijt} = a_j + b_{ij} + v_{ijt}$. The brother correlation, ρ_{Y_i,Y_k}, is then

$$\rho_{Y_i,Y_j} = \frac{\sigma_a^2}{\sigma_a^2 + \sigma_b^2} \tag{5}$$

In order to estimate the brother correlation, we need to estimate both variances σ_a^2 and

σ_b^2. Björklund et al. (2009) show that it is important to take into account the persistence in the transitory term, v_{ijt}, in this estimation. We use their GMM approach under the assumption that the transitory term follows an AR(1) process, i.e. $v_{ijt} = \lambda v_{ijt-1} + u_{ijt}$, where u_{ijt} is a mean zero, constant variance random shock to current income.[7]

4 Data

Documenting social mobility imposes two requirements on data. First, we need reasonable proxies of lifetime income for both parents and their children. This means that we need to observe the income at an age when the association of annual income and lifetime income is reasonably strong. In addition, we need to link family members together in order to have information on individual's own income as well as the income of their fathers and, in part of the analysis, their brothers. These criteria determine our estimation sample which contains information on individuals born between 1932 and 1974 and their fathers and brothers. We also examine the cohort born in 1974–79 in our analysis for educational attainment.

Our main data is derived from several longitudinal databases maintained by Statistics Norway, which include information on demographic and socio-economic characteristics of the entire Norwegian population. We augment these data with census data from 1960 and military records from early 1950s (see below for details). All data sources include personal identifiers and thus allows us to link them together as well as to link children to their parents and brothers. The information for family links come from the Norwegian population register, which was established in the early 1960s using information collected in the 1960 national and local censuses. For men born after 1950, we can identify virtually all mothers (and thus brothers). For the earlier cohorts, we identify most fathers and mothers until the cohorts born in the mid 1930s and more than a third for the cohorts born in the early 1930s.

[7] In order to make our results as comparable as possible with Björklund et al. (2009), we use the same birth cohorts and focus on brothers born within seven calendar years of each other. We differ from their specification in measuring income at age 35–44 (instead of 30–38) due to data restrictions. Furthermore, we conduct inference using block bootstrap with brother pairs as the unit of resampling.

4.1 Sons' and Brothers' income

Our measure for sons' income comes from the tax register, which records annual (pre-tax) income for years 1967–2010. Our income measure is the sum of labor income (from wages and self-employment) and work-related cash transfers (such as unemployment benefits and short-term sickness benefits). We measure income at age 35 for all birth cohorts, because the oldest sons included in our analysis were born in 1932 (and are thus 35 years old in 1967 when we first observe their income). This measure allows us to observe sons' income for the cohorts born between 1932 and 1974. We also examine sons' educational attainment, which we measure using information from the education register.

Income at age 35 should provide us with a reasonable proxy for lifetime income (Böhlmark & Lindquist, 2006; Bhuller et al., in press). By this age most men have completed their education and have entered the labor market. In Tables A1 and A2 in the online Appendix, we show that the intergenerational income elasticity and the rank-rank slope estimates are slightly larger when we measure son's income at ages 30–34, 35–39 or 40–44 rather than at age 35. However, the differences are small and do not alter our conclusions regarding the trend in social mobility. Virtually all sons are found from the register, but seven and nine percent of them have zero income at the age of 35. We include these observations in the analysis using percentile ranks, but omit them from the log specifications for estimating intergenerational income elasticity.

4.2 Fathers' income

We use two complementary approaches for measuring fathers' income. First, we directly observe fathers' annual income from the tax register for those fathers, who are still of working age in 1967 and for whom we can establish father-son links from the population register. These conditions are fulfilled for virtually everyone in the later birth cohorts. For earlier cohorts, however, we face the challenge that many of the fathers are at the end of their work careers or already retired in 1967. Thus our primary measure of fathers' income is his average income at age 55–64, when the sons are, on average, 29.6 years old. Importantly, while measuring fathers' income at a quite late age may lead to some measurement error, the resulting attenuation bias is likely to be similar for all birth cohorts.

Despite measuring fathers' income at a late age, the share of sons for whom we directly observe father's income declines as we move towards earlier birth cohorts. This could distort our conclusions if the subpopulation for whom we observe fathers' income differs from the full population in terms of their intergenerational mobility. In order to examine this possibility, we construct an alternative measure of father's income using military records. In Norway, military service is mandatory for all young men of normal health. In the cohorts born between the 1930s and 1950s roughly 75% of men served in the military (Rossow & Amundsen, 1986). Importantly, the military recorded information on the occupation of the father for each conscript (but not father's identification number). We have access to the full draft records for men born in 1932–33. For other cohorts, we observe fathers' occupation from the 1960 census, provided that we observe the father-son link from the population register.

We use the information on fathers' occupation and son's residence municipality to impute income for the fathers. This imputation is based on Statistics Norway's publication (1950) that reports information on average salaries by occupation in 735 Norwegian municipalities based on 1948 tax records. As the military records provide us with information on the father's occupation in twenty categories, we can use these pieces of information to impute father's income using over 10,000 income values from the tax records.[8] These sources allow us to construct imputed father income for almost 80% of men born in 1932–33. The match is somewhat lower for the late 1930s and the 1940s cohorts, but increases to 95% for the cohorts born in the early 1950s.

The strength of our two proxies for fathers' lifetime income is that their limitations are very different from each other. The tax register provides accurate information on income, but these income measures come from late stages of the fathers' careers.[9] On the other hand, the match of sons to fathers is not perfect for the early 1930s cohorts. In contrast, the quality of the imputed income measure is likely to improve as we move towards the earlier cohorts. The reason is that the imputation is based on the 1948 tax records and thus occupation–municipality level averages are a better proxy for fathers'

[8]This is a major improvement on the earlier papers such as Pekkala and Lucas (2007) that have relied on simple occupational averages to proxy for fathers' incomes in the earliest cohorts.

[9]In the online Appendix, we show that estimates using fathers' income rank are not sensitive to the age at which fathers' income is measured (Table A1), but the intergenerational income elasticity estimates tend to be substantially larger when fathers' income is measured at a younger age (Table A2). Importantly, these differences do not affect our conclusions regarding trends in social mobility.

true income if the father was in his prime working age around 1948.

Table A3 in the online Appendix presents a closer examination of the relationship between the two measures by reporting estimates from regressing fathers' observed income on his imputed income among those fathers for whom we observe both measures. The results show strong correlation among the cohorts born in the 1930s, slightly less correlation among the 1940s birth cohorts and even less correlation among the 1950–54 birth cohort. This pattern is consistent with the hypothesis that measurement error in imputed income becomes more severe as we move towards later birth cohorts. Consequently, we expect attenuation bias to increase over time in analysis based on imputed income.

5 Results

This section presents our main results. We start with intergenerational rank-rank slopes, and compare them to traditional intergenerational income elasticities as well as to the brother correlations. The last subsection examines nonlinearities in the association between fathers' and sons' income percentile ranks.

5.1 Rank-rank Slope

Table 1 reports estimates from regressing sons' percentile rank at age 35 in the income distribution of his birth cohort on their fathers' percentile rank in the fathers' income distribution (i.e. relative to other fathers with children in the same birth cohort). Each estimate pair comes from a separate regression which differs in the birth cohort used in the estimation (columns) and the way we approximate father's lifetime income (panels). In panel A, we use fathers' average annual income at age 55–64. The results show that the intergenerational rank correlation decreased from 0.28 in the cohort born in 1932–33 to 0.20 in the cohort born in 1940–44. This drop corresponds to an almost 30% decrease in the rank-rank slope and is highly statistically significant. For the cohorts born after the WWII, the intergenerational rank correlation remains remarkably stable. Panel B reports similar estimates for a restricted sample, where we have excluded those in the bottom and top deciles of father's income distribution from the estimation sample. The results are very similar to those obtained from the full sample.

Panel C of table 1 reports the estimates using imputed fathers' income. For the

1932–33 birth cohort, the sample size increases eightfold in comparison to that when using fathers' observed income. However, the estimate for the rank-rank slope is very similar to those reported in panels A and B. Furthermore, we again find a clear decline in intergenerational rank-rank slope between cohorts born in the early 1930s and early 1940s. In relative terms the drop, from 0.25 to 0.16, is larger than when using actual income. After the cohort born in 1945, the rank-rank slopes continue to decline, but at a much slower pace. These later declines are likely to reflect increasing attenuation bias as the 1948 average occupation-municipality earnings become an increasingly worse proxy for fathers' true income (see section 4.2 for discussion).

5.2 Intergenerational Income Elasticity

Table 2 reports estimates for intergenerational income elasticity using identical approach as for the rank-rank slopes above. In panel A, we use father's actual income at age 55–64 to proxy for his lifetime income. Again, we observe a clear drop in the intergenerational persistence between the cohorts born in the early 1930s and early 1940s after which intergenerational income elasticity remains roughly constant.

Panel B of table 2 illustrates the importance of the tails of the father income distribution for the estimation of intergenerational income elasticities. The estimates reported in panel B come from otherwise identical regressions as those reported in panel A, but we now omit observations from the top and bottom decile of fathers' income distribution. As a consequence, the estimated elasticities increase by 69–129%.

However, while the levels of the elasticity estimates are highly sensitive to including or excluding the tails of fathers' income distribution, the trends presented in panels A and B are rather similar. Between the 1932–33 and 1940–44 birth cohorts, the elasticity drops by 43% in the full sample and by 33% in the restricted sample, and remains roughly constant afterwards with the exception of the elasticity rising slightly in the trimmed sample between cohorts born in the late 1940s and late 1950s, and then declining back to the late 1940s level.

Panel C of table 2 confirms the same patterns when using father's imputed income to proxy for his lifetime income. The estimates are very similar to those using the trimmed sample of father's observed income. The elasticity estimates decline by 32% between birth cohorts born in the early 1930s and early 1940s, and remain roughly stable for the

remaining birth cohorts.

5.3 Brother Correlations

Since the measurement of father's lifetime income is somewhat incomplete in the intergenerational regressions reported above, it is useful to compare our intergenerational results to the estimates of brother income correlations. In table 3 we report estimates for the components of the income variance together with estimates for autocorrelation in the transitory shock and the overall brother correlation. The main estimates concern the family component σ_a^2 and the individual component σ_b^2. In order to ease comparisons, we have replicated the cohort and income definitions of Björklund et al. (2009) as closely as possible (see footnote 7).

The second and third columns of table 3 report a clear declining trend in the family component which falls by a third between cohorts born in the 1930s and the 1940s. As a consequence, brother correlation in income decreases, which provides further evidence on the decreasing importance of family background. The estimated levels and trends of brother correlations during this period are very similar to those reported by Björklund et al. (2009) for Sweden, suggesting that similar mechanisms are likely to be behind the changes in social mobility in Sweden and Norway.

Interestingly, the brother correlation in income continues to decline also among the cohorts for whom father-son rank correlations and intergenerational income elasticities remain stable. These diverging patterns suggest that the importance of the factors shared by brothers, but not related to fathers' income, continued to lose their importance. This could be due to, for example, a decrease in residential income segregation, the quality of education becoming more similar across schools, or other factors related to social class not picked up by the fathers' income. However, a full examination of these potential mechanisms is beyond the scope of this study.

Figure 1 summarizes our results thus far by plotting together the rank-rank slopes, intergenerational elasticities and brother correlations from our preferred specifications. It illustrates that while the alternative specifications give different levels of the persistence estimates, all estimation approaches suggest that social mobility increased between cohort born in the early 1930s and early 1940s. For the cohorts born after WWII, father-son associations remain stable, while the brother correlations continue to decline. The

stability of father-son associations for cohorts born after WWII is in line with earlier results for the US (Aaronson & Mazumder, 2008; Lee & Solon, 2009; Chetty, Hendren, Kline, Saez, & Turner, 2014) and for Norway (Bratberg et al., 2005). For the pre-WWII birth cohorts, brother correlations are similar to earlier results for Sweden (see above). However, the continuing decline of brother correlations in Norway among the post-WWII birth cohorts differs from the results of Björklund et al. (2009), who find a slight increase in brother correlations in Sweden starting from the cohort born in the mid-1950s.

5.4 Trends Across the Parental Income Distribution

The estimates discussed above are consistent with various patterns of mobility. For example, the drop in income persistence between the cohorts born in the early 1930s and 1940s could be driven by increases in the upward mobility of the sons from low- or middle income families or, alternatively, by increased downward mobility from the top of the fathers' income distribution. A shortcoming of the summary measures of mobility that Chetty, Hendren, Kline, and Saez (2014) classify as "measures of relative mobility" is that they do not distinguish between these possibilities. Thus, next we focus on estimating absolute mobility measures over fathers' income distribution.

In order to assess in which part of the income the changes in mobility took place, Figure 2 present the results for four birth cohorts by plotting the expected sons' income percentile against his fathers' income percentile.[10] We follow Chetty, Hendren, Kline, and Saez (2014) and divide the horizontal axis into 100 percentile bins and plot the mean son income percentile for each bin. The figure also includes a linear fit corresponding to the rank-rank slope estimates reported in table 1 and local linear estimates for the sons' expected income rank over the income distribution of fathers. Table 4 reports the local linear estimates for some fathers' income percentiles for all birth cohorts included in our data.

Figure 2 and Table 4 present a complex picture of the evolution of the joint father-son income percentile distribution. The association between fathers' and sons' income percentile ranks is highly nonlinear among the early cohorts, but approaches linearity over time. Nevertheless, changes in the rank-rank slope estimates (Table 1), and a comparison

[10]The corresponding figures for the remaining birth cohorts, and for using fathers' imputed income, are presented in Figures A2 and A3 in the online Appendix. We also report transition matrices for fathers' and sons' income quintiles in Table A7.

of the predicted percentile ranks at the bottom and and the top of father's income distribution (Table 4), lead to similar conclusions: both suggest that the difference in average income ranks between sons coming from the top and the bottom of fathers' income distribution has dropped from roughly 30 to roughly 20 percentiles. On the other hand, the expected income percentiles remain remarkably stable for sons whose fathers are between the 50th and the 75th percentile, while the expected income rank for sons of fathers at the 25th percentile steadily increases over time. Furthermore, upward mobility from the bottom of father's income distribution increases among cohorts born before early 1940s and then declines from the late 1950s birth cohort onwards. Finally, and most notably, the average income percentile of sons of the highest-income fathers, declines steadily over time. For example, the expected percentile rank of sons of the fathers at the 95th percentile, declines from 67th for those born in the early 1930s into 60th for those born in the early 1970s.

In order to place our results into a context, we compare them to contemporary United States.[11] The expected income percentile of Norwegian men born in the 1932–33 cohorts to the fathers at the 95th income percentile, is very close to the expected percentile of Americans born in 1980–82 in families at the 95th percentile of the parental income distribution (67th in Norway vs. 66th in the US). On the other hand, the expected income percentile of Norwegians born in the 1930s to fathers at the 5th percentile, is already much higher than that in the contemporary United States (41st in Norway vs. 34th in the United States). It is also informative to contrast the changes over time in Norway to geographical variation in the contemporary U.S. According to the preferred measure used by Chetty, Hendren, Kline, and Saez (2014)–the expected income percentile of children growing up in families at the 25th percentile–Norwegian men born in 1932–33 experienced absolute upward mobility comparable to the mid-ranking locations in the current United States such as Denver or Buffalo. In contrast, the absolute upward mobility for Norwegian cohorts born in 1970–74 is comparable to the most mobile locations in the U.S. such as Salt Lake City or Pittsburgh.

[11]The information for the United States is from the online Appendix to Chetty, Hendren, Kline, and Saez (2014). It is important to keep in mind that our measures refer to the personal income of the sons and their fathers, while Chetty, Hendren, Kline, and Saez (2014) measure income at the family level.

6 Education as a Potential Mechanism

While several alternative mechanisms may give rise to changes in social mobility, much of the discussion has focused on the role of human capital and changes in the production technology. Theoretical work such as Becker and Tomes (1979), Solon (2004), Hassler et al. (2007), and Ichino et al. (2011) has shown that educational policies that decrease the cost of education for the offspring of disadvantaged families tend to increase social mobility.[12] On the other hand, changes in production technology that increase returns to skill may create incentives for the poor families to invest in education, and lead to higher mobility. In this section, we present a set of stylized facts that examine these potential mechanisms. However, we stress that our analysis is purely descriptive and thus does not provide strong evidence on the causal impacts of educational reforms or changes in the production process.

6.1 Education and Income

Table 5 summarizes the trends in educational attainment in Norway over our observation period. Average years of education increased by 2.7 years or 27% between the cohorts born in the early 1930s and late the 1970s. These changes are partly due to the educational reforms discussed in section 2 that made attendance in secondary education universal. In addition, the share of the birth cohorts obtaining a college degree increased dramatically in parallel with the expansion of the college and university sector.

The next two columns of Table 5 present estimates from regressing log income at age 35 on years of education (column 3) or an indicator for having a college degree (column 4).[13] Between the cohorts born in the early 1930s and the late 1940s, the association between log income and years of education decreases by 18% and returns to a college degree by 31%. This change is consistent with the hypothesis that the increased supply of educated workers decreased returns to education. However, among cohorts born after 1950, returns to education increased substantially even though the supply of educated workers continued to increase. This pattern is consistent with demand for

[12] See Björklund and Salvanes (2011) for an overview of empirical research on education and family background.

[13] In Figure A4 in the online Appendix we show that the relationship between income and years of education is roughly linear and thus single regression coefficients provide a meaningful summarization of this association.

educated workers increasing faster than the supply (see e.g. Goldin and Katz (2009) for discussion).[14]

6.2 Education and Parental Background

We now turn to changes in the relationship between educational attainment and family background. Figure 3 and Table A12 present the results for years of education using an identical approach as used in section 5.4 for income percentile ranks. That is, we use local linear regressions to estimate the expected years of education across the fathers' income percentile.

Figure 3 reveals a highly convex relationship between parental background and years of education, particularly among the early birth cohorts. For the cohorts born between the 1930s and the 1950s, the relationship is very steep above the 80th percentile rank and fairly flat below that. For the later birth cohorts, the relationship slowly becomes more linear as the sons of the low- and middle-income fathers steadily increase their educational attainment, while the education of sons of the high-income fathers remains remarkably stable. As a consequence, the gap between the expected years of education of sons born to the fathers at the 95th and 5th percentiles decreases from three to two years between cohorts born in the late 1930s and early 1970s (table A12).[15]

Figure 4 and Table 7 repeat the analysis for the likelihood of the son obtaining a college degree. The pattern is qualitatively similar as for years of education, but more pronounced across fathers' income distribution. About a tenth of the sons born in the 1930s into families below the 70th percentile in fathers' income distribution, had a college degree, while almost 70% of the sons of the highest income families did. Above the 80th percentile, the association between fathers' income rank and sons' likelihood of getting a college degree was very steep. The strong association at the top of the distribution remains

[14]For brevity, we refer to the association between income and educational attainment as "returns to education". We recognize that this association may not measure a causal relationship, because unobserved factors are likely to affect educational choices. Furthermore, the nature of the selection process may change over time.

[15]For completeness, columns 5–6 of Table 5 report estimates from regressing sons' years of education on fathers' observed income percentile. These estimates, and those reported in the first column of Table A12, indicate that men born in 1932–33 for whom we observe fathers' income in the tax register, have low educational attainment. The most likely explanation is that for this cohort, we can observe fathers at age 55–64 in 1967 only if the father was quite young when the son was born. In the online Appendix, we show that the expected years of education evolve smoothly over the early birth cohorts when we replicate Table A12 using fathers' imputed income.

over time, even though the pattern otherwise becomes more linear as the likelihood to obtain a college degree increases amon the sons of low-income, and particularly, middle-income fathers.

7 Conclusions

In this paper, we have documented trends in social mobility among Norwegian men during the period when Norway transformed from a poor and unequal country into one of the world's richest economies with extensive redistributive institutions. According to all of our measurement approaches, social mobility increased between cohorts born in the early 1930s and the early 1940s. The increase in mobility coincides with an equalization in educational attainment across fathers' income distribution and declining association between income and education. These patterns are consistent with a hypothesis that the expansion of public provision of education simultaneously leveled educational opportunities and a reduced returns to education. However, it is important to keep in mind that these results are purely descriptive. Thus examining the causal impact of educational reforms affecting these birth cohorts may be a particularly promising avenue for future research.

The results for the post-WWII birth cohorts are more mixed. Father-son income correlations remained stable between cohorts born in the late 1940s and the early 1970s, while brother correlations and the expected income rank of the sons of the highest and lowest earning fathers declined. At the same time, returns to education increased and the educational attainment of children coming from low- and middle-income families grew rapidly. These patterns are consistent with a hypothesis that increasing returns to education would tend to reduce social mobility, while the continuing equalization of educational attainment would push towards more mobility. A possible interpretation is that these forces largely offset each other during this period. We stress again, that while the stylized facts are consistent with such an interpretation, there remains much scope for future research that would put these hypotheses into a more rigorous test.

References

Aaberge, R., & Atkinson, A. B. (2010). Top Incomes in Norway. *Top Incomes: A Global Perspective*, *2*.

Aaronson, D., & Mazumder, B. (2008). Intergenerational economic mobility in the United States, 1940 to 2000. *Journal of Human Resources*, *43*(1), 139–172.

Becker, G. S., & Tomes, N. (1979). An equilibrium theory of the distribution of income and intergenerational mobility. *The Journal of Political Economy*, 1153–1189.

Bhuller, M., Mogstad, M., & Salvanes, K. G. (in press). Life cycle earnings, education premiums and internal rates of return. *Journal of Labor Economics*.

Björklund, A., & Jäntti, M. (2009). Intergenerational income mobility and the role of family background. *Oxford Handbook of Economic Inequality, Oxford University Press, Oxford*, 491–521.

Björklund, A., Jäntti, M., & Lindquist, M. J. (2009). Family background and income during the rise of the welfare state: Brother correlations in income for Swedish men born 1932–1968. *Journal of Public Economics*, *93*(5), 671–680.

Björklund, A., & Salvanes, K. G. (2011). Education and family background: Mechanisms and policies. In S. M. Eric A. Hanushek & L. Woessmann (Eds.), *Handbook of the Economics of Education* (Vol. 3, p. 201 - 247). Elsevier.

Black, S. E., & Devereux, P. J. (2011). Recent developments in intergenerational mobility. *Handbook of Labor Economics*, *4*, 1487–1541.

Blanden, J., Goodman, A., Gregg, P., & Machin, S. (2011). Changes in Intergenerational Mobility in Britain. In M. Corak (Ed.), *Generational Income Mobility in North America and Europe* (pp. 122–146). Cambridge University Press.

Böhlmark, A., & Lindquist, M. J. (2006). Life-cycle variations in the association between current and lifetime income: Replication and extension for sweden. *Journal of Labor Economics*, *24*(4), 879–896.

Bratberg, E., Nilsen, Ø. A., & Vaage, K. (2005). Intergenerational earnings mobility in Norway: Levels and trends. *The Scandinavian Journal of Economics*, *107*(3), 419–435.

Bratsberg, B., Røed, K., Raaum, O., Naylor, R., Eriksson, T., et al. (2007). Nonlinearities in intergenerational earnings mobility: Consequences for cross-country comparisons. *Economic Journal*, *117*(519), C72–C92.

Bütikofer, A., Løken, K. V., & Salvanes, K. (2016). *Long-term consequences of access to*

well-child visits. (IZA DP 9546)

Bütikofer, A., Mølland, E., & Salvanes, K. G. (2016). *Introducing a Free Nutritious School Breakfast: Long-Term Impacts on Education and Adult Earnings.* (Working paper, Norwegian School of Economics)

Carneiro, P., Løken, K. V., & Salvanes, K. G. (2015). A flying start? maternity leave benefits and long-run outcomes of children. *Journal of Political Economy*, *123*(2), 365–412.

Chetty, R., Hendren, N., Kline, P., & Saez, E. (2014). Where is the land of opportunity? The geography of intergenerational mobility in the United States. *Quarterly Journal of Economics*, *129*(4), 1553–1623.

Chetty, R., Hendren, N., Kline, P., Saez, E., & Turner, N. (2014). Is the United States still a land of opportunity? Recent trends in intergenerational mobility. *American Economic Review*, *104*(5), 141–47.

Clark, G. (2012). What is the true rate of social mobility in Sweden? A surname analysis, 1700-2012. *Manuscript, Univ. California, Davis*.

Corak, M. (2013). Income inequality, equality of opportunity, and intergenerational mobility. *Journal of Economic Perspectives*, *27*(3), 79-102.

Goldin, C. D., & Katz, L. F. (2009). *The Race between Education and Technology.* Harvard University Press.

Grytten, O. H. (2004). *The gross domestic product for norway, 1830–2003.* (Occasional Papers, Bank of Norway)

Grytten, O. H. (2014). *Growth in public finances as tool for control: Norwegian development 1850-1950.* (Working paper, Norwegian School of Economics)

Haider, S., & Solon, G. (2006). Life-cycle variation in the association between current and lifetime earnings. *American Economic Review*, *96*(4), 1308–1320.

Hassler, J., Mora, J. V. R., & Zeira, J. (2007). Inequality and mobility. *Journal of Economic Growth*, *12*(3), 235–259.

Ichino, A., Karabarbounis, L., & Moretti, E. (2011). The political economy of intergenerational income mobility. *Economic Inquiry*, *49*(1), 47–69.

Jäntti, M., & Jenkins, S. P. (2013). Income mobility.

Lee, C.-I., & Solon, G. (2009). Trends in intergenerational income mobility. *The Review of Economics and Statistics*, *91*(4), 766–772.

Lefranc, A., & Trannoy, A. (2005). Intergenerational earnings mobility in France: Is

France more mobile than the US? *Annales d'Economie et de Statistique*, 57–77.

Lindahl, M., Palme, M., Sandgren Massih, S., & Sjögren, A. (2015). Long-term intergenerational persistence of human capital: An empirical analysis of four generations. *Journal of Human Resources*, *50*(1), 1–33.

Long, J., & Ferrie, J. (2013). Intergenerational occupational mobility in Great Britain and the United States since 1850. *The American Economic Review*, *103*(4), 1109–1137.

Modalsli, J. (2015). *Intergenerational mobility in norway, 1865-2011.* (Statistics Norway DP 798)

Nicoletti, C., & Ermisch, J. F. (2008). Intergenerational earnings mobility: changes across cohorts in britain. *The BE Journal of Economic Analysis & Policy*, *7*(2).

Nybom, M., & Stuhler, J. (2014). *Biases in standard measures of intergenerational income dependence.* (Mimeo)

Olivetti, C., & Paserman, M. D. (2015). In the Name of the Son (and the Daughter): Intergenerational Mobility in the United States, 1850-1940. *American Economic Review*, *105*(8), 2695-2724.

Olivetti, C., Paserman, M. D., & Salisbury, L. (2013). *Intergenerational mobility across three generations in the 19th century: Evidence from the US Census* (Tech. Rep.). Mimeo., Boston University.

Pekkala, S., & Lucas, R. E. (2007). Differences across cohorts in Finnish intergenerational income mobility. *Industrial Relations*, *46*(1), 81–111.

Rossow, I., & Amundsen, A. (1986). *The Norwegian Conscript Study: A Description of Data Collection, Linkage of Registers, and Establishment of Data Files.* (Unpublished manuscript)

Solon, G. (1992). Intergenerational income mobility in the united states. *The American Economic Review*, 393–408.

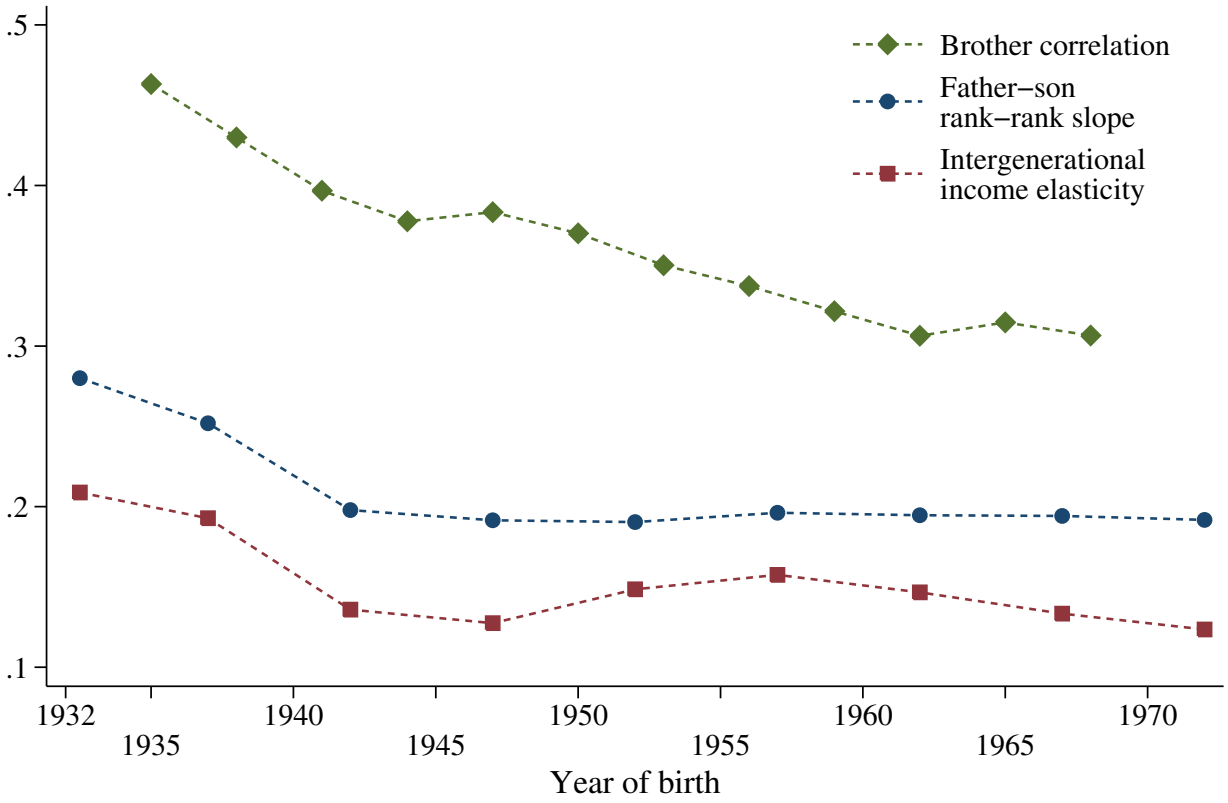
Solon, G. (1999). Intergenerational mobility in the labor market. *Handbook of labor economics*, *3*, 1761–1800.

Solon, G. (2004). A model of intergenerational mobility variation over time and place. *Generational income mobility in North America and Europe*, 38–47.

Statistics Norway. (1950). *Skattestatistikken for Budsjettåret 1948 (Tax Statistics 1947/48).* (Oslo)

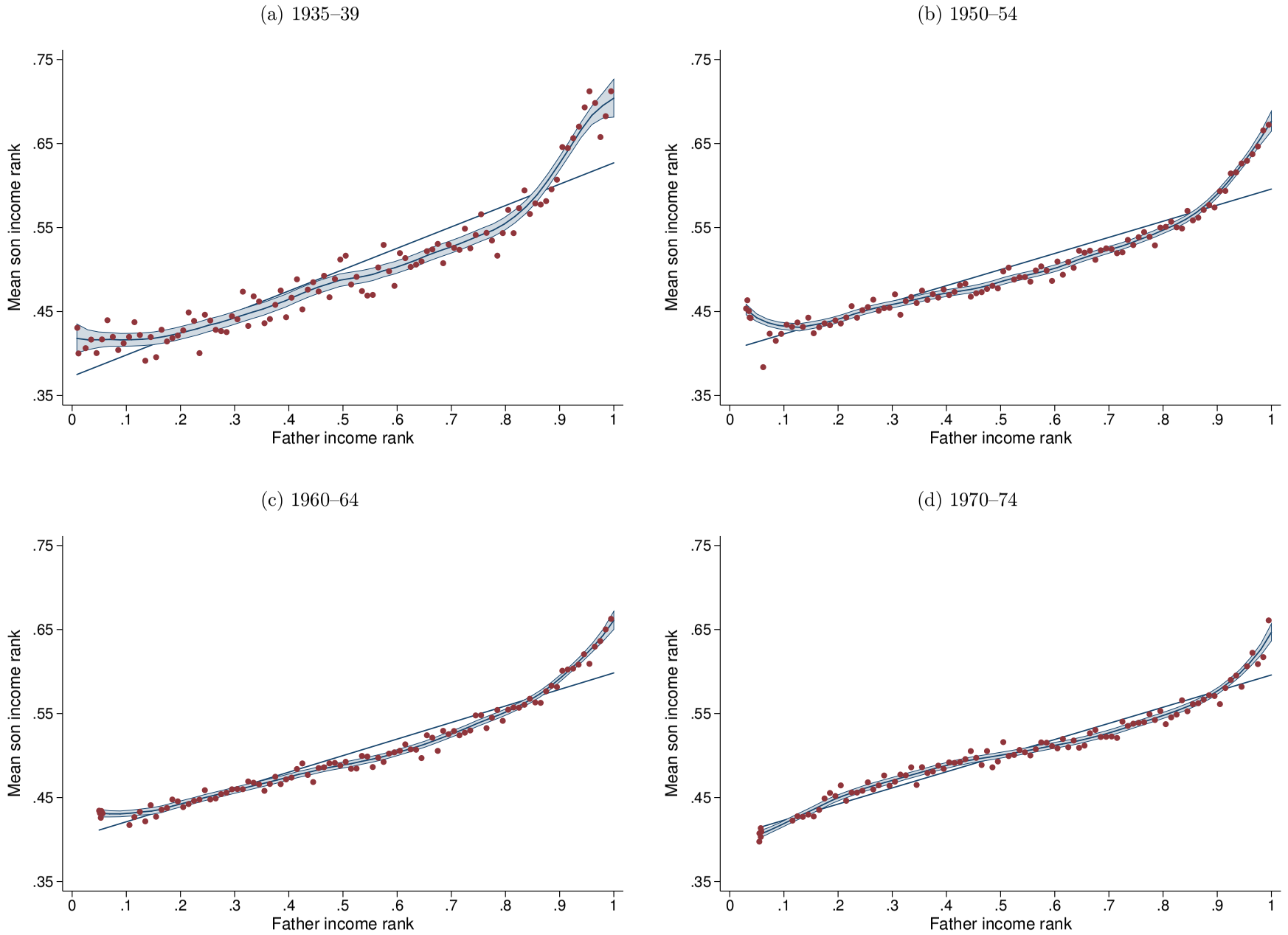
Statistics Norway. (1995). *Historical statistics 1994.* (Oslo and Kongsvinger: Statistisk Sentralbyrå)

Figure 1: Trends in social mobility



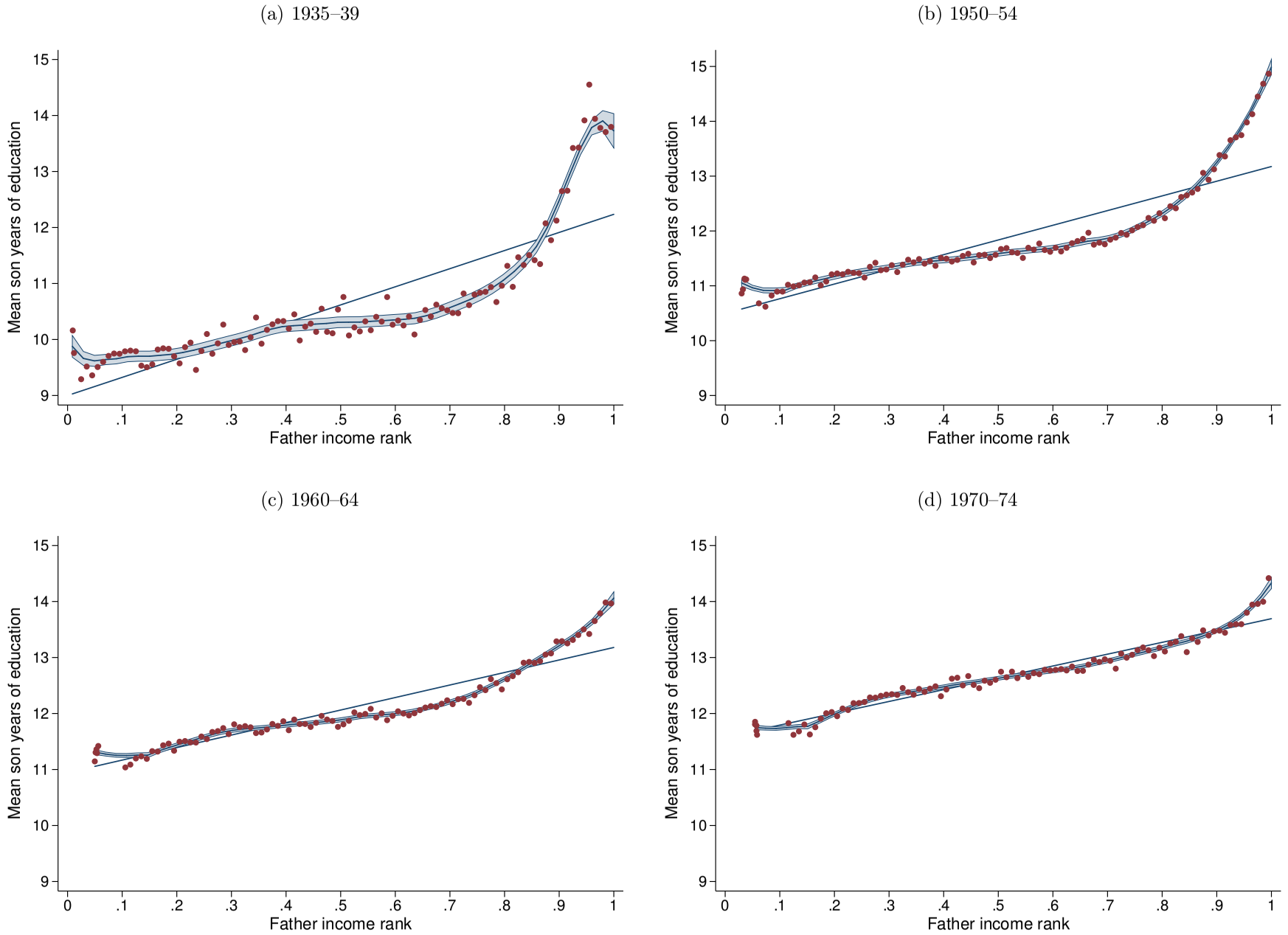
Note: This figure presents the point estimates for rank-rank slopes from regressing son's income percentile on father's income percentile, intergenerational income elasticities from regressing son's log income on father's log income, and brother income correlations estimated using the GMM approach of Björklund et al. (2009). Each estimate comes from a separate regression. In the intergenerational regressions, son's income is measured at age 35 and father's income at age 55–64 using pre-tax annual income. Intergenerational income elasticities are estimated using a sample that omits the top and bottom decile of fathers' income distribution. For brother correlations, we use pre-tax annual income at age 35–44 and include only brothers born within seven calendar years of each other.

Figure 2: Association between son's and father's income percentile ranks



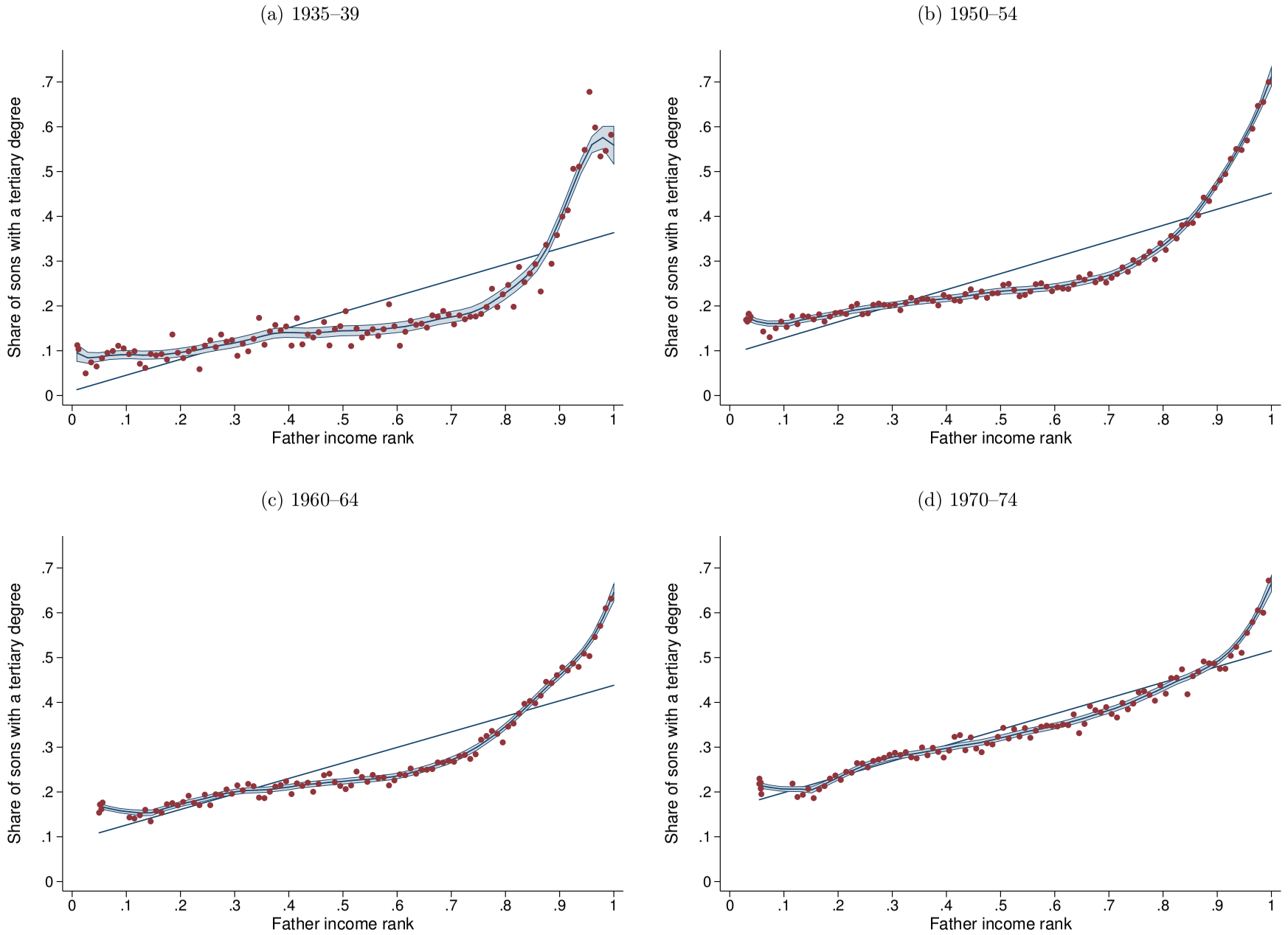
Note: Sons' expected income percentile rank at age 35 as a function of his father's income percentile rank at age 55–64. Each curve is estimated with a local linear regression using edge (triangle) kernel and Stata's rule-of-thumb bandwidth selection routine. The shaded areas correspond to 95% confidence intervals.

Figure 3: Association between son's years of education and father's income percentile rank



Note: Sons' expected years of education as a function of father's income rank at age 55–64. Each curve is estimated with a local linear regression using edge (triangle) kernel and Stata's rule-of-thumb bandwidth selection routine. The shaded areas correspond to 95% confidence intervals.

Figure 4: Association between son's likelihood of obtaining a college degree and father's income percentile rank



Note: Sons' probability to hold a college degree as a function of father's income rank at age 55–64. Each curve is estimated with a local linear regression using edge (triangle) kernel and Stata's rule-of-thumb bandwidth selection routine. The shaded areas correspond to 95% confidence intervals.

Table 1: Rank-rank regressions

	Son's birth cohort								
	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54	1955 –59	1960 –64	1965 –69	1970 –74
	A: Father's average percentile rank at age 55-64								
Father's income percentile	0.280	0.252	0.198	0.192	0.190	0.196	0.195	0.194	0.192
	(0.015)	(0.006)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Constant	0.322	0.380	0.419	0.416	0.411	0.407	0.410	0.405	0.406
	(0.009)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	3,909	32,114	78,526	130,079	140,411	150,457	152,663	165,436	156,723
R^2	0.08	0.06	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	B: Father's average precentile rank at age 55-64, excluding bottom and top decile								
Father's income percentile	0.272	0.217	0.173	0.174	0.173	0.182	0.180	0.176	0.163
	(0.021)	(0.007)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)
Constant	0.314	0.386	0.421	0.415	0.411	0.406	0.410	0.411	0.420
	(0.011)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	3,125	25,688	62,803	104,037	112,312	120,379	121,213	129,554	123,326
R^2	0.05	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	C: Father's imputed income rank								
Father's earnigs precentile	0.251	0.214	0.165	0.148	0.133	.	.	.	.
	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)				
Constant	0.377	0.383	0.426	0.432	0.437	.	.	.	.
	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)				
Observations	31,568	55,075	97,074	142,569	145,105				
R^2	0.07	0.05	0.03	0.02	0.02				

Note: Estimates and robust standard errors (in paratheses) from regressing son's income percentile at age 35 in his birth cohort on measures of his father's income percentile.

Table 2: Intergenerational income elasticities

	Son's birth cohort								
	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54	1955 –59	1960 –64	1965 –69	1970 –74
	A: Father's average income at age 55-64, full								
Father's log income	0.121	0.109	0.069	0.064	0.067	0.068	0.064	0.062	0.060
	(0.011)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	3,529	29,634	72,165	117,057	123,032	126,959	126,706	136,156	130,623
R^2	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
	B: Father's average income at age 55-64, excluding bottom and top decile								
Father's log income	0.209	0.193	0.136	0.127	0.149	0.158	0.147	0.133	0.123
	(0.020)	(0.008)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Observations	2,826	23,797	57,907	93,995	98,733	102,074	101,834	109,376	104,934
R^2	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01
	C: Father's imputed income								
Father's log income	0.229	0.228	0.156	0.143	0.142	.	.	.	.
	(0.006)	(0.005)	(0.004)	(0.003)	(0.004)				
Observations	29,879	51,581	91,497	133,976	135,891				
R^2	0.05	0.04	0.02	0.01	0.01				

Note: Estimates and robust standard errors (in paratheses) from regressing son's log income at age 35 in his birth cohort on measures of his father's log income.

Table 3: Brother correlations

	Variance component			Auto-	Sibling
	Family	Individual	Error	correlation	correlation
Birth cohort:	σ_a^2	σ_b^2	σ_v^2	λ	ρ
1932–1938	0.070	0.081	0.126	0.583	0.463
	(0.005)	(0.004)	(0.004)	(0.032)	(0.024)
1935–1941	0.059	0.078	0.121	0.547	0.430
	(0.004)	(0.004)	(0.004)	(0.027)	(0.024)
1938–1944	0.050	0.076	0.122	0.567	0.397
	(0.003)	(0.004)	(0.004)	(0.026)	(0.024)
1941–1947	0.044	0.073	0.131	0.635	0.378
	(0.003)	(0.004)	(0.004)	(0.026)	(0.025)
1944–1950	0.049	0.078	0.137	0.637	0.383
	(0.003)	(0.005)	(0.004)	(0.029)	(0.029)
1947–1953	0.053	0.090	0.154	0.637	0.370
	(0.003)	(0.006)	(0.005)	(0.033)	(0.033)
1950–1956	0.052	0.096	0.166	0.669	0.350
	(0.004)	(0.006)	(0.005)	(0.031)	(0.029)
1953–1959	0.054	0.106	0.168	0.650	0.337
	(0.004)	(0.007)	(0.006)	(0.036)	(0.032)
1956–1962	0.054	0.114	0.163	0.652	0.322
	(0.004)	(0.007)	(0.005)	(0.034)	(0.028)
1959–1965	0.054	0.122	0.154	0.648	0.306
	(0.004)	(0.006)	(0.005)	(0.037)	(0.027)
1962–1968	0.056	0.122	0.146	0.646	0.315
	(0.005)	(0.004)	(0.004)	(0.024)	(0.017)

Note: Point estimates and block bootstrapped standard errors (in parentheses) using 1,000 replications. See Section 4 for discussion.

Table 4: Son's expected income percentile by father's income percentile

	Birth cohort								
Father's percentile:	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54	1955 –59	1960 –64	1965 –69	1970 –74
95th	0.672	0.676	0.647	0.634	0.629	0.626	0.621	0.610	0.603
	(0.013)	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
90th	0.629	0.627	0.600	0.594	0.590	0.592	0.591	0.584	0.577
	(0.010)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
75th	0.549	0.540	0.532	0.531	0.534	0.536	0.539	0.539	0.537
	(0.009)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
50th	0.490	0.488	0.482	0.486	0.485	0.488	0.489	0.492	0.500
	(0.010)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
25th	0.415	0.433	0.447	0.445	0.451	0.452	0.451	0.457	0.461
	(0.009)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
10th	0.407	0.416	0.434	0.434	0.433	0.429	0.431	0.424	0.419
	(0.010)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
5th	0.413	0.416	0.441	0.443	0.443	0.436	0.431	0.419	0.404
	(0.013)	(0.005)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)

Note: Local linear estimates and standard errors (in parentheses). The estimates come from local linear regression using edge (triangle) kernel and Stata's rule-of-thumb bandwidth selection routine where we regress sons' income percentile at age 35 on his father's income percentile at age 55–64. The estimates for each column come from a separate regression.

Table 5: Trends in educational attainment

			Assocation between log income at 35 and		Assocation between father's income rank and			
	Years of	Tertiary	Years of	Tertiary	Years of education		Tertiary degree	
	education	degree	education	degree	Cons.	Slope	Cons.	Slope
1932-33	10.0	0.13	0.062	0.41	8.4	2.3	0.00	0.18
1935-39	10.5	0.17	0.065	0.41	9.0	3.2	0.01	0.35
1940-44	11.1	0.22	0.052	0.30	9.7	3.1	0.06	0.36
1945-49	11.4	0.24	0.051	0.28	10.1	2.9	0.08	0.36
1950-54	11.8	0.27	0.060	0.29	10.5	2.7	0.09	0.36
1955-59	12.0	0.26	0.075	0.35	10.8	2.4	0.09	0.34
1960-64	12.0	0.26	0.074	0.31	10.9	2.2	0.09	0.35
1965-69	12.3	0.29	0.073	0.31	11.2	2.2	0.12	0.35
1970-74	12.6	0.34	0.074	0.29	11.6	2.1	0.16	0.35
1975-79	12.6	0.36	0.080	0.31	11.7	2.0	0.19	0.37

Note: Columns 1-2 report average years of education and the share obtaining a tertiary degree for each birth cohort. Column 3 reports OLS point estimates from regressing log annual income at age 35 on years of education. Column 4 reports similar estimates when using an indicator variable for tertiary degree as a measure of education. Columns 5–6 report the estimates from regressing son's years of education on father's income rank. Columns 7–8 report similar estimates for son's tertiary degree.

Table 6: Son's expected years of education by father's income percentile

	Birth cohort									
Father's percentile:	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54	1955 –59	1960 –64	1965 –69	1970 –74	1975 –79
95th	11.7	13.6	13.9	13.9	14.0	13.8	13.5	13.6	13.8	13.8
	(0.16)	(0.06)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
90th	10.6	12.5	12.9	13.1	13.2	13.3	13.2	13.3	13.5	13.5
	(0.12)	(0.06)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
75th	9.8	10.8	11.4	11.7	12.0	12.2	12.4	12.8	13.1	13.2
	(0.11)	(0.05)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
50th	9.4	10.3	11.0	11.2	11.6	11.8	11.9	12.2	12.6	12.7
	(0.11)	(0.05)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
25th	9.0	9.9	10.6	10.9	11.3	11.5	11.6	11.8	12.2	12.3
	(0.11)	(0.05)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
10th	8.8	9.7	10.2	10.6	10.9	11.1	11.2	11.5	11.7	11.8
	(0.10)	(0.05)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
5th	8.9	9.6	10.2	10.5	11.0	11.2	11.3	11.5	11.8	11.7
	(0.12)	(0.05)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)

Note: Local linear estimates and standard errors (in parentheses). The estimates come from local linear regression using edge (triangle) kernel and Stata's rule-of-thumb bandwidth selection routine where we regress sons' years of education on his father's income percentile at age 55–64. The estimates for each column come from a separate regression.

Table 7: Son's likelihood of obtaining a tertiary degree by father's income percentile

	Birth cohort									
Father's percentile:	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54	1955 –59	1960 –64	1965 –69	1970 –74	1975 –79
95th	0.31	0.54	0.57	0.57	0.57	0.54	0.53	0.52	0.55	0.59
	(0.02)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
90th	0.16	0.39	0.45	0.46	0.47	0.46	0.46	0.46	0.49	0.53
	(0.02)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
75th	0.08	0.19	0.26	0.28	0.30	0.29	0.30	0.36	0.40	0.46
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
50th	0.08	0.14	0.20	0.22	0.23	0.22	0.22	0.26	0.32	0.35
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
25th	0.05	0.11	0.16	0.18	0.19	0.18	0.19	0.22	0.26	0.30
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
10th	0.04	0.09	0.13	0.15	0.16	0.15	0.16	0.18	0.21	0.23
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
5th	0.04	0.09	0.13	0.15	0.17	0.17	0.17	0.18	0.22	0.22
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: Local linear estimates and standard errors (in parentheses). The estimates come from local linear regression using edge (triangle) kernel and Stata's rule-of-thumb bandwidth selection routine where we regress an indicator for the son holding a tertiary degree on his father's income percentile at age 55–64. The estimates for each column come from a separate regression.

A1 Appendix

Tables A1 and A2: Age at measuring income

Tables A8 and A9 report estimates for rank-rank slopes and intergenerational income elasticities when measuring fathers' and sons' earnings at different ages. For reference, the first row of panels A shows the estimates reported in the main paper, while the remaining rows report estimates corresponding to different ages for measuring son's earnings. Since our earnings data start in 1967 and ends in 2010, we do not observe sons' earnings before age 35 for the early cohorts nor earnings after age 35 for the late cohorts. Panels B reports similar estimates, but now measuring fathers' earnings at age 45–54. Using age 45–54 earnings does not allow us to measure rank-rank-correlations for the cohorts born before 1945. The estimates for rank-rank slopes are quite insensitive to the age at which son's or father's income is measured. Measuring son's income over longer periods yields somewhat somewhat larger estimates than when using a single year, while measuring fathers' income at age 45–54 tends to yield slightly smaller estimates than when using income at age 55–64. However, all these differences are quite small and, most importantly, all measures show similar trends. The estimates for intergenerational income elasticity are, again, not largely affected by the time when we measure son's income. However, elasticity estimates using fathers' income at age 44–54 are 64–94% larger than estimates

Table A3: Imputation vs. observed father's income

In order to examine the quality of the imputed income measures, we compare fathers' observed and imputed income among those individuals for whom our data contain both measures. Table A10 reports results from regressions:

$$P_{i,obs} = \alpha + \beta P_{i,imp} + \epsilon_i \tag{A6}$$

where $P_{i,obs}$ is the observed father's income rank (from the tax register) at age 55-64 for individual i, $P_{i,imp}$ is the imputed father's income rank, and ϵ_i is an error term.

The first column examines sons born between 1932–33. For this cohort, we can use the military records to construct imputed father's income rank for 33,100 individuals, while the actual father's income rank at age 55–64 is observed only for 4,086 individuals. Both measures are available for 4,008 men. They are highly correlated, but by no means identical. The R-squared from regressing father's observed income on his imputed income is 0.14. This relatively low R-squared reflects both measurement error inherent in our imputations and changes in the true income rank of the father's between early 1950s and the time when they were 55–64 years

old. The remaining columns report similar analysis for the later cohorts. The point estimate and R-squared are largest among the 1935–39 birth cohort and smallest among the 1950–54 birth cohort. This pattern is consistent with an increasing measurement error over birth cohorts.

Tables A4–A6: Son's expected outcomes by father's imputed income

Tables A11 and A12 replicate tables 5 and 8 of the main paper using father's imputed income (instead of father's observed income at age 55–64).

Table A7: Transition matrices

Table A14 presents quintile transition matrices for four birth cohots. Each entry in a matrix corresponds to the probability that a son of father in a given quintile (columns) ends up in a quintile in the son income distribution (rows). For instance, 39.7% of sons growing up in the top quintile in the 1935–39 birth cohort were themselves in the top quintile at age 35.

A2 Figures

Figures A1-A3: Shape of the father-son income associations

Figure A5 shows the relationship between father's and son's log income. It is constructed by dividing father's log income (x-axis) into 100 percentile bins and plotting the mean son log income for each bin (y-axis). The figure also includes a linear fit corresponding to intergenerational income elasticity estimates reported in table 4 of the main paper.

Figure A6 reports the association between son's and father's income ranks for all birth cohorts in our data using the procedure described in section 5.3 of the main paper. Figure A7 shows the corresponding analysis when using father's imputed income.

Figure A4: Log income on years of education

In table 5 of the main paper, we report estimates from regressing income at 35 on years of education. Figure A8 shows that these regression coefficients provide a reasonable characterisation of the relationship between income and education, i.e. that the relationship is approximately linear. Figure A8 also plots the distribution of years of education for the birth cohorts included in our data.

Table A8: Sensitivity to the age at measuring income: Rank-rank slopes

	Son's birth cohort								
	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54	1955 –59	1960 –64	1965 –69	1970 –74
	A: Father's average income percentile at age 55–64								
Sons' income rank at age 35	0.280	0.252	0.198	0.192	0.190	0.196	0.195	0.194	0.192
	(0.015)	(0.006)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Sons' income rank at age 30–34	.	.	0.212	0.194	0.183	0.199	0.195	0.189	0.179
			(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Sons' income rank at age 35–39	0.294	0.264	0.217	0.216	0.208	0.209	0.207	0.206	.
	(0.015)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	
Sons' income rank at age 40–44	0.283	0.268	0.230	0.225	0.203	0.206	0.204	.	.
	(0.015)	(0.006)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)		
	B: Father's average income percentile at age 45–54								
Sons' income rank at age 35	.	.	0.194	0.214	0.211	0.217	0.218	0.216	0.207
			(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Sons' income rank at age 30–34	.	.	0.211	0.215	0.205	0.224	0.217	0.213	0.197
			(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Sons' income rank at age 35–39	.	.	0.212	0.240	0.230	0.229	0.230	0.227	.
			(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	
Sons' income rank at age 40–44	.	.	0.222	0.242	0.221	0.224	0.223	.	.
			(0.005)	(0.003)	(0.003)	(0.003)	(0.003)		

Table A9: Sensitivity to the age at measuring income: Intergenerational income elasticity

	Son's birth cohort								
	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54	1955 –59	1960 –64	1965 –69	1970 –74
	A: Father's average log income at age 55–64								
Sons' log income at age 35	0.121	0.109	0.069	0.064	0.067	0.068	0.064	0.062	0.060
	(0.011)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sons' log income at age 30–34	.	.	0.069	0.055	0.058	0.068	0.068	0.067	0.062
			(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sons' log income at age 35–39	0.126	0.112	0.071	0.075	0.082	0.085	0.078	0.070	0.065
	(0.012)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Sons' log income at age 40–44	0.126	0.109	0.090	0.094	0.094	0.094	0.079	.	.
	(0.013)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)		
	B: Father's average log income at age 45–54								
Sons' log income at age 35	.	.	0.114	0.117	0.124	0.127	0.126	0.106	0.097
			(0.006)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Sons' log income at age 30–34	.	.	0.120	0.098	0.111	0.127	0.132	0.117	0.099
			(0.006)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Sons' log income at age 35–39	.	.	0.120	0.139	0.150	0.153	0.145	0.122	0.107
			(0.006)	(0.005)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)
Sons' log income at age 40–44	.	.	0.160	0.162	0.174	0.164	0.147	.	.
			(0.008)	(0.006)	(0.005)	(0.004)	(0.004)		

Table A10: Associations between fathers' observed and imputed income

	Son's birth cohort				
	1932–33	1935–39	1940–44	1945–49	1950–54
	A: Earnings rank				
Father's imputed earnings rank	0.38	0.44	0.37	0.30	0.25
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Constant	0.31	0.26	0.31	0.35	0.38
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
R^2	0.14	0.18	0.13	0.09	0.06
Observations	3,855	30,529	74,843	126,225	138,614
	B: Log earnings				
Father's imputed log earnings	0.55	0.63	0.56	0.51	0.45
	(0.03)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	5.40	4.59	5.48	6.13	6.75
	(0.34)	(0.13)	(0.09)	(0.07)	(0.07)
R^2	0.08	0.10	0.07	0.05	0.04
Observations	3,736	29,922	72,790	120,649	129,106

Note: Estimates and robust standard errors (in paratheses) from regressing father's observed income on his imputed rank. In panel A, the outcome variable is father's observed income rank at age 55–64 and the dependent variable is father's imputed income rank. In panel B, the outcome variable is father's observed log earnings at age 55–64 and the dependent variable is father's imputed income rank.

Table A11: Son's expected income percentile by father's imputed income percentile

	Son's expected percentile by birth cohort				
Father's percentile:	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54
95th	0.643	0.605	0.590	0.577	0.569
	(0.005)	(0.004)	(0.003)	(0.002)	(0.002)
90th	0.614	0.581	0.565	0.554	0.544
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
75th	0.563	0.550	0.548	0.532	0.529
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
50th	0.488	0.478	0.505	0.506	0.501
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
25th	0.442	0.432	0.466	0.471	0.476
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
10th	0.414	0.414	0.434	0.434	0.435
	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
5th	0.401	0.417	0.436	0.436	0.436
	(0.005)	(0.003)	(0.003)	(0.002)	(0.002)

Table A12: Son's expected years of education by father's imputed income percentile

	Son's expected percentile by birth cohort				
Father's percentile:	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54
95th	12.0	12.3	12.7	12.9	13.1
	(0.06)	(0.05)	(0.03)	(0.03)	(0.03)
90th	11.0	11.4	11.7	11.8	12.1
	(0.05)	(0.04)	(0.03)	(0.03)	(0.02)
75th	10.7	11.3	11.7	11.7	12.0
	(0.05)	(0.04)	(0.03)	(0.03)	(0.02)
50th	9.7	10.4	11.0	11.3	11.7
	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)
25th	9.3	9.9	10.6	11.1	11.6
	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)
10th	9.1	9.7	10.3	10.8	11.3
	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)
5th	9.0	9.7	10.3	10.7	11.1
	(0.05)	(0.04)	(0.03)	(0.03)	(0.02)

Table A13: Son's expected college degree by father's imputed income percentile

	Son's expected percentile by birth cohort				
Father's percentile:	1932 –33	1935 –39	1940 –44	1945 –49	1950 –54
95th	0.34	0.37	0.42	0.43	0.46
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
90th	0.21	0.26	0.28	0.29	0.32
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
75th	0.20	0.26	0.30	0.29	0.29
	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
50th	0.12	0.16	0.21	0.25	0.25
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
25th	0.09	0.11	0.17	0.20	0.23
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
10th	0.06	0.10	0.14	0.17	0.19
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
5th	0.06	0.10	0.14	0.15	0.18
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Table A14: Quintile transition matrices

(a) 1935–39

Child	Father quintile				
quintile	1	2	3	4	5
1	27.1%	23.7%	16.6%	14.0%	13.1%
2	25.3%	24.6%	24.1%	19.8%	11.1%
3	19.3%	19.5%	22.4%	23.5%	14.8%
4	15.7%	17.8%	20.0%	22.4%	21.3%
5	12.6%	14.3%	16.9%	20.3%	39.7%

(b) 1950–53

Child	Father quintile				
quintile	1	2	3	4	5
1	25.9%	22.3%	18.1%	15.4%	14.3%
2	22.3%	22.8%	22.9%	19.2%	12.6%
3	19.3%	20.7%	21.4%	21.8%	17.3%
4	17.7%	18.5%	20.3%	22.9%	22.2%
5	14.9%	15.8%	17.3%	20.8%	33.6%

(c) 1960–64

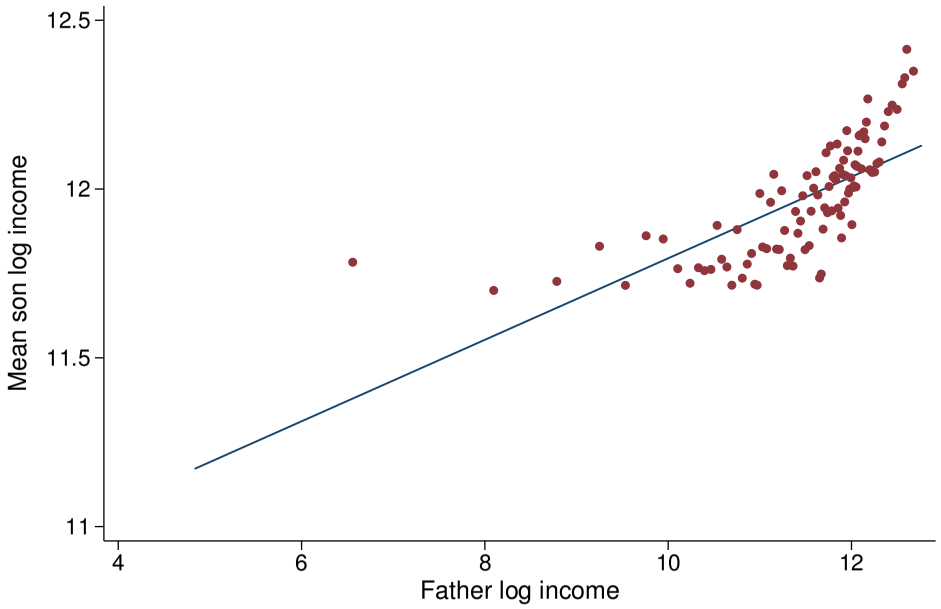
Child	Father quintile				
quintile	1	2	3	4	5
1	25.6%	21.5%	17.3%	15.1%	14.9%
2	22.9%	23.6%	22.5%	19.1%	12.8%
3	19.9%	20.7%	22.2%	22.0%	16.5%
4	17.6%	19.1%	20.7%	22.4%	21.7%
5	14.0%	15.1%	17.2%	21.4%	34.2%

(d) 1970–74

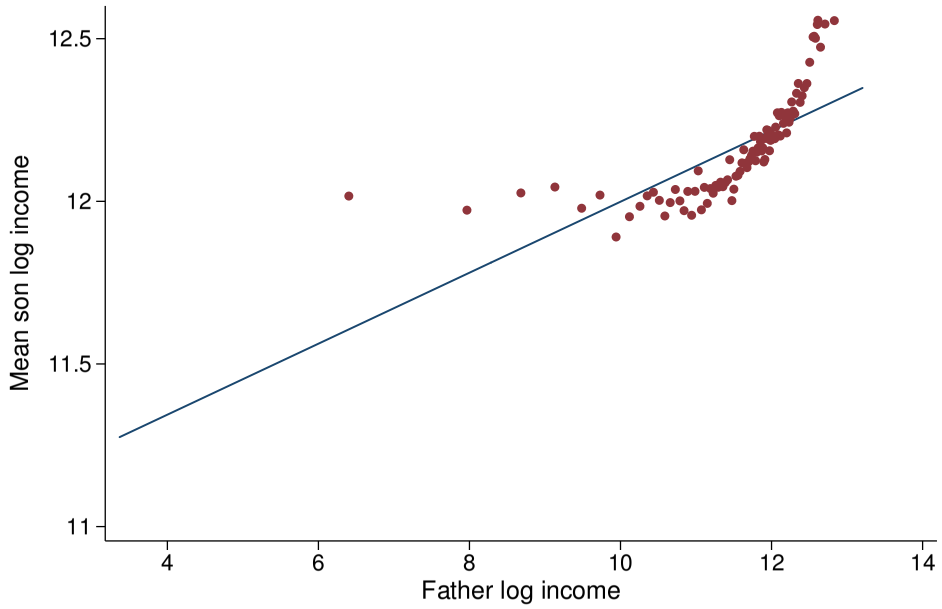
Child	Father quintile				
quintile	1	2	3	4	5
1	29.1%	21.1%	16.9%	15.9%	15.7%
2	22.4%	22.8%	22.1%	19.2%	13.7%
3	18.5%	20.9%	21.8%	21.6%	17.6%
4	16.5%	19.3%	21.0%	21.6%	22.0%
5	13.5%	16.0%	18.3%	21.8%	31.0%

Figure A5: Son's log income at 35 on father's log income at 55–64

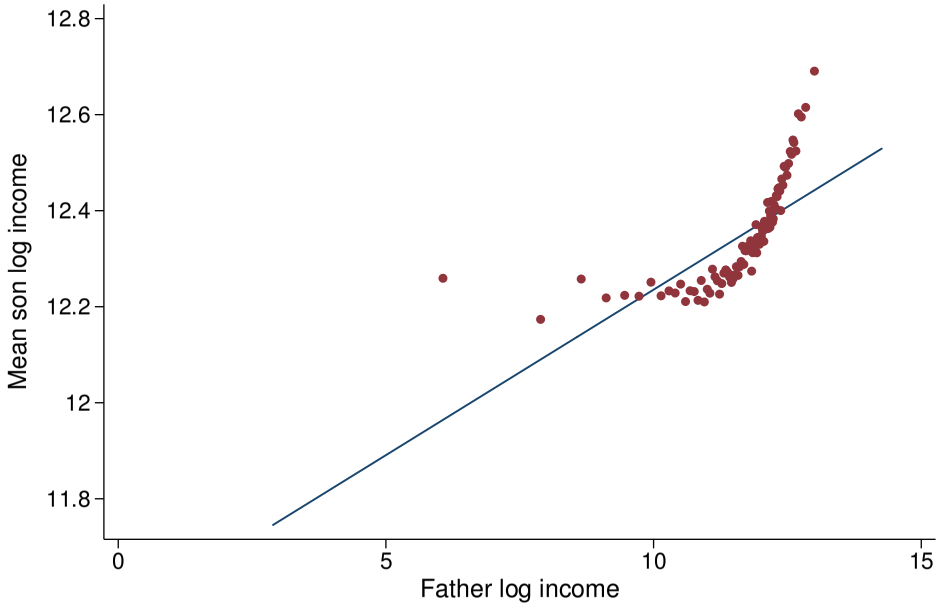
(a) 1932–33



(b) 1935–39



(c) 1940–44



(d) 1945–49

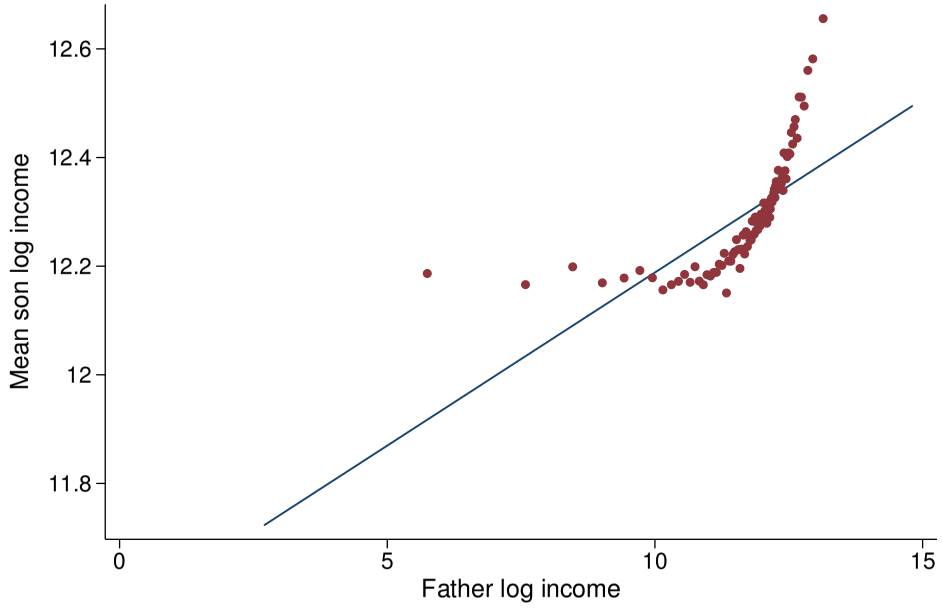
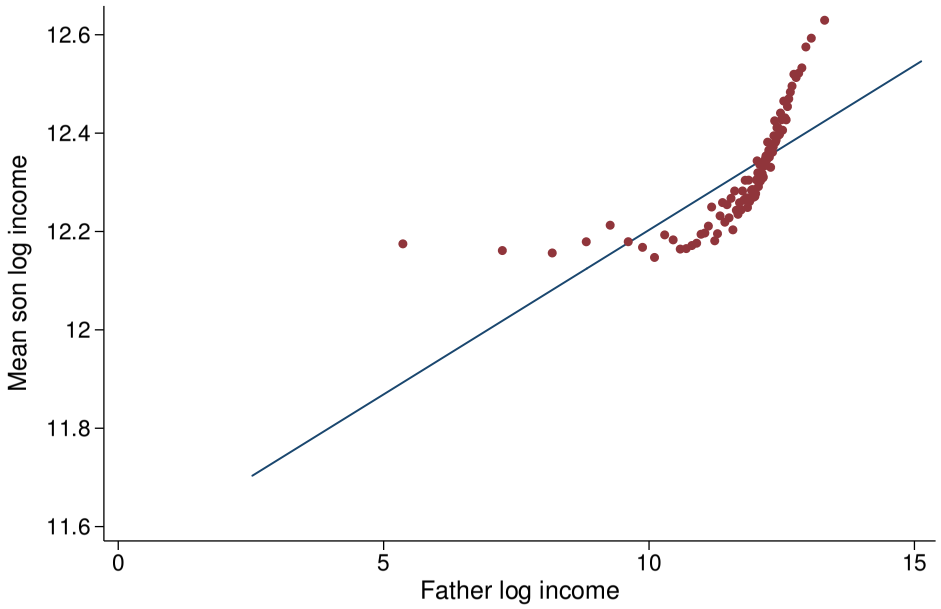
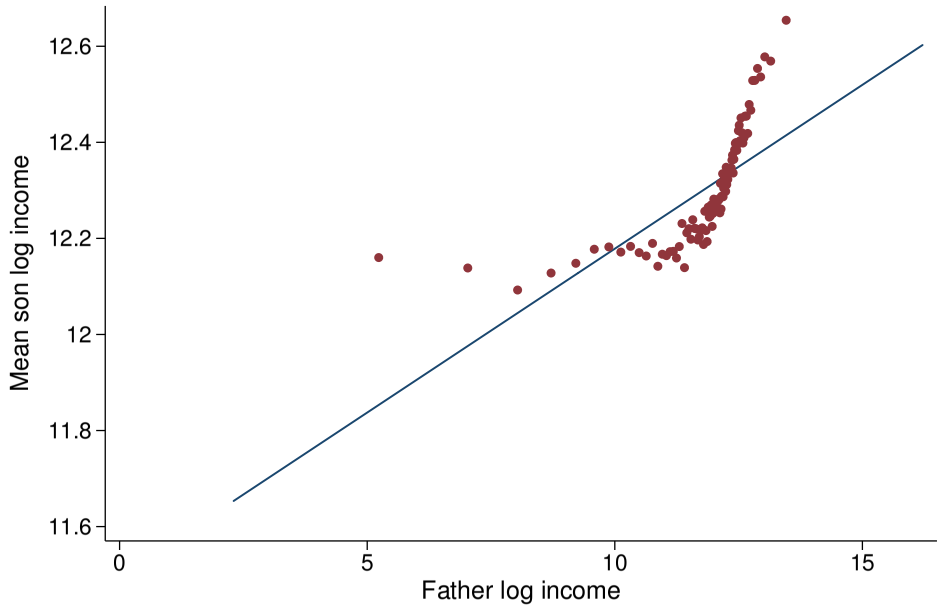


Figure A5: (cont') Son's log income at 35 on father's log income at 55–64

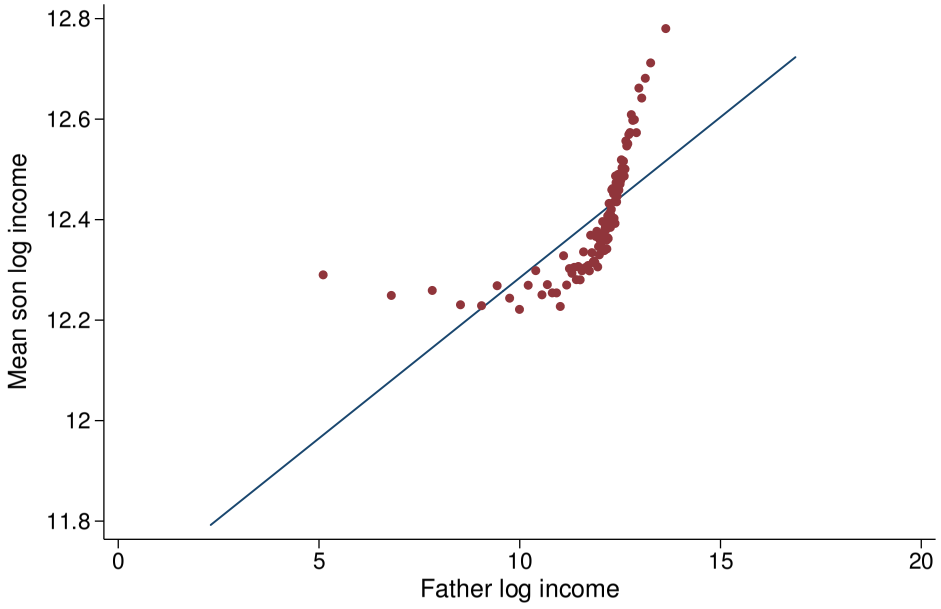
(e) 1950–54



(f) 1955–59



(g) 1960–64



(h) 1965–69

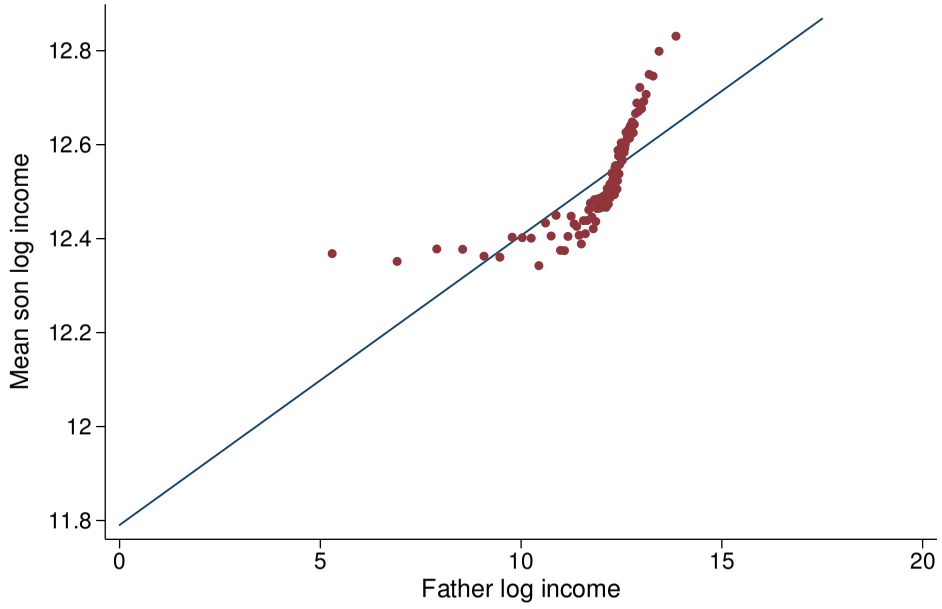
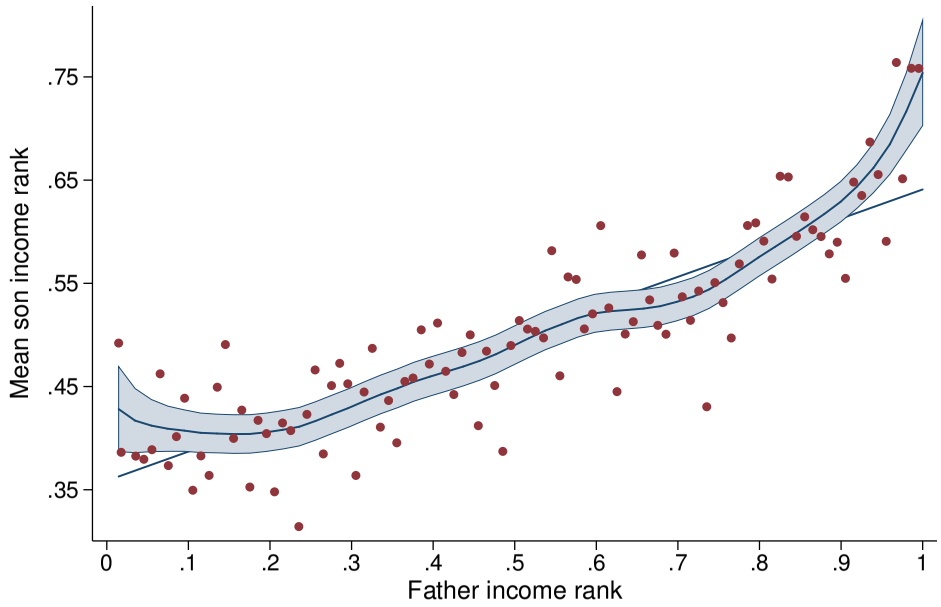
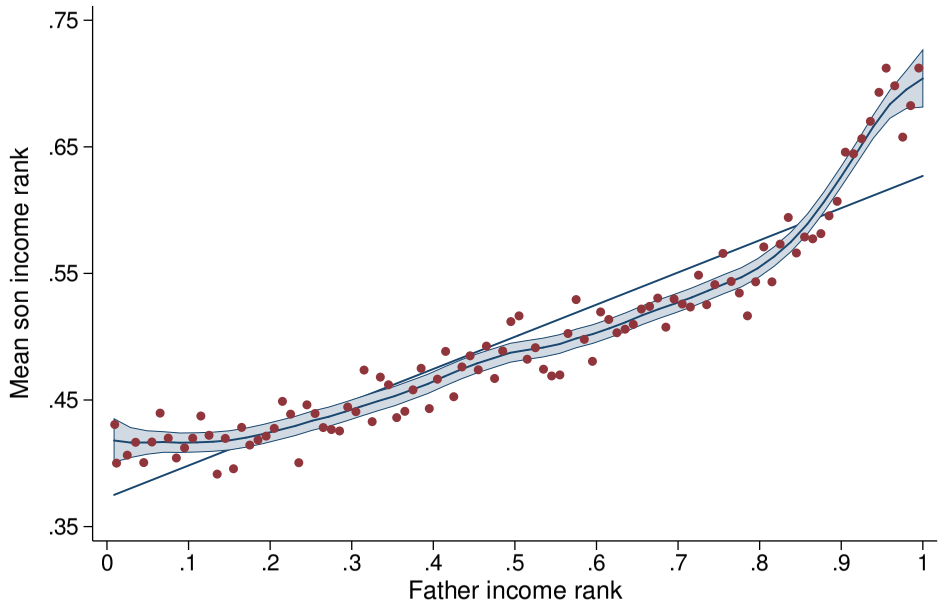


Figure A6: Son's income percentile at 35 on father's income percentile at 55–64

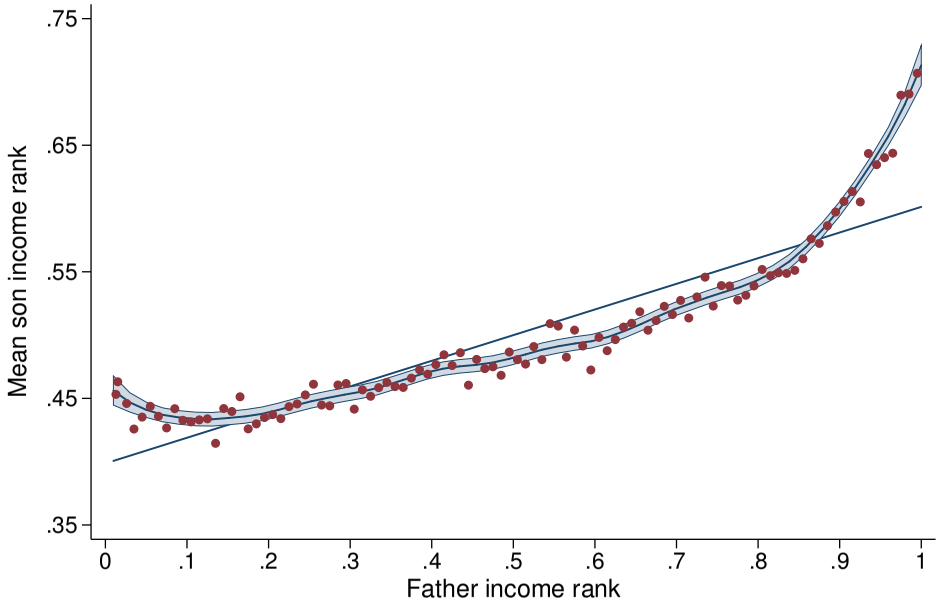
(a) 1932–33



(b) 1935–39



(c) 1940–44



(d) 1945–49

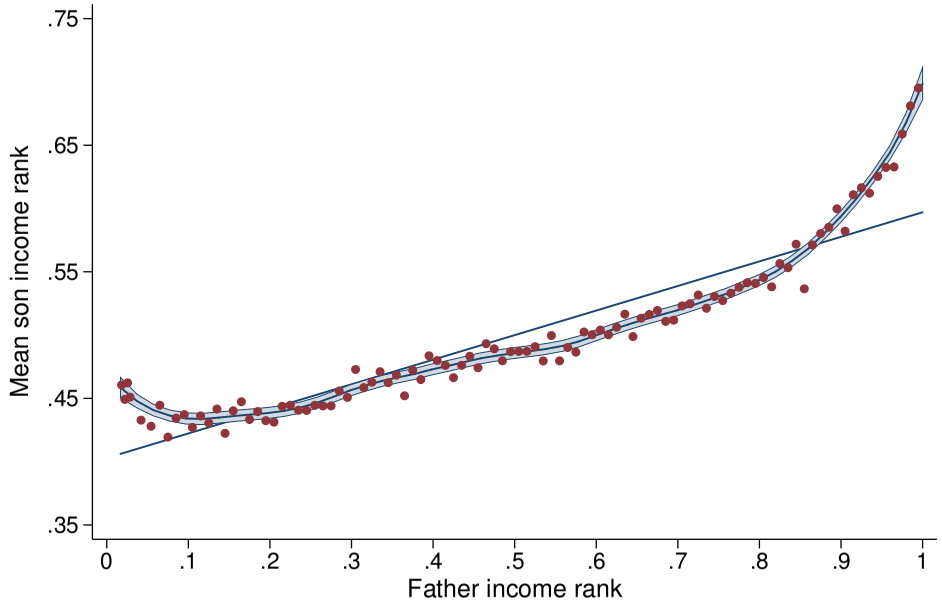
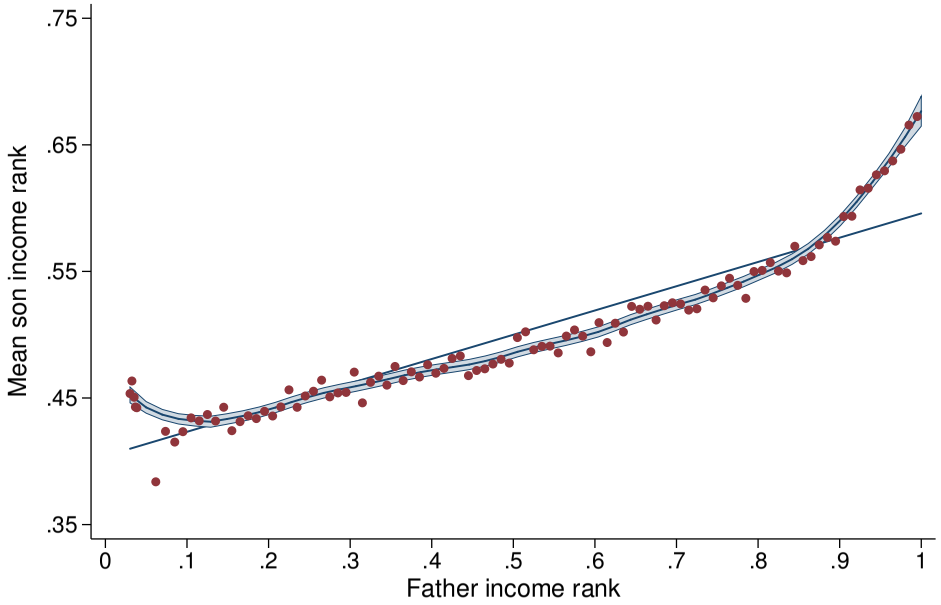
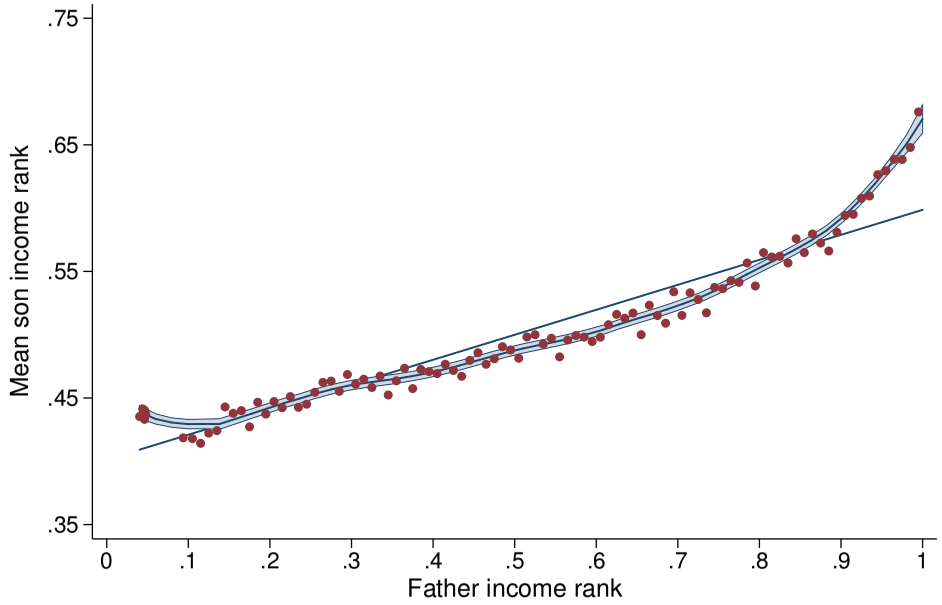


Figure A6: (cont') Son's income at 35 on father's income at 55–64

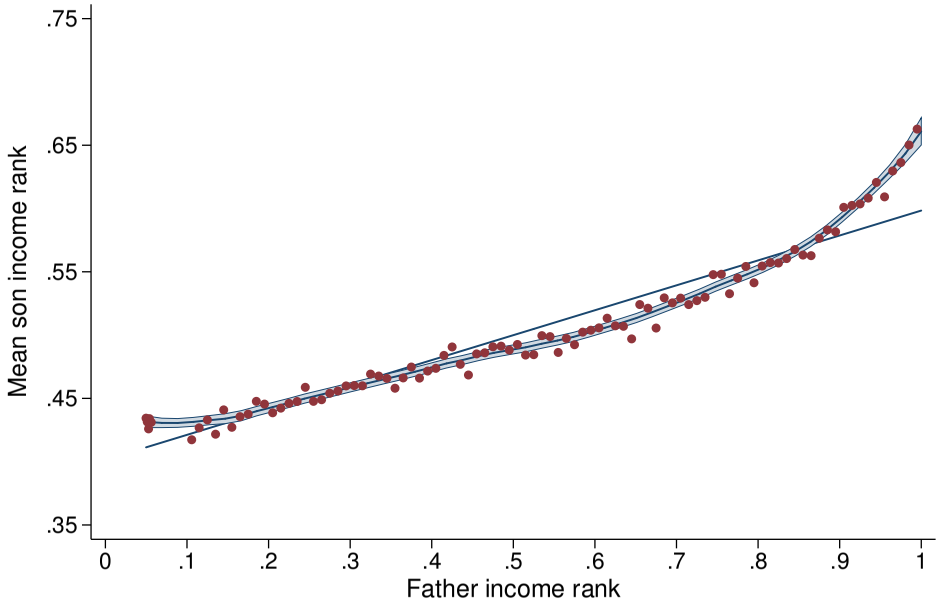
(e) 1950–54



(f) 1955–59



(g) 1960–64



(h) 1965–69

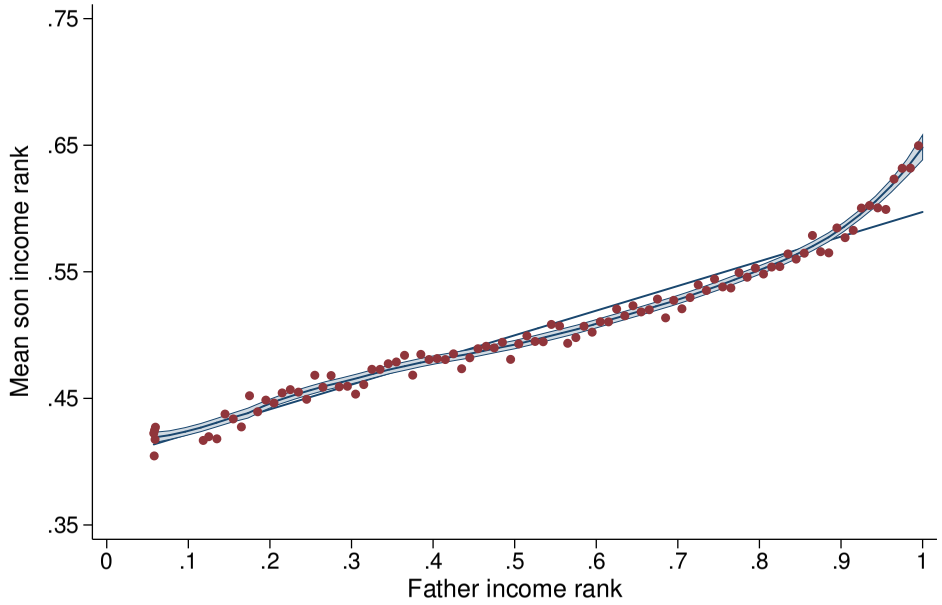
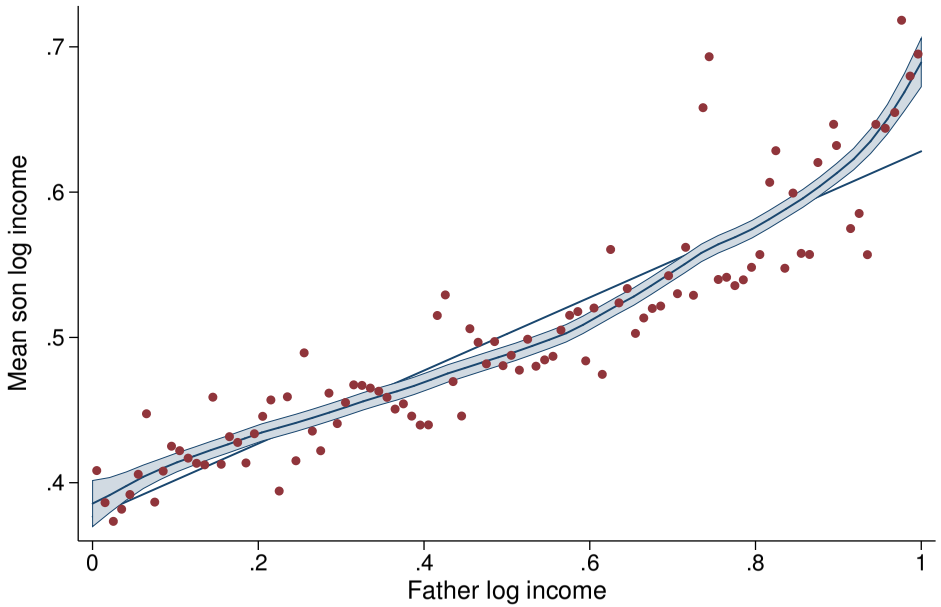
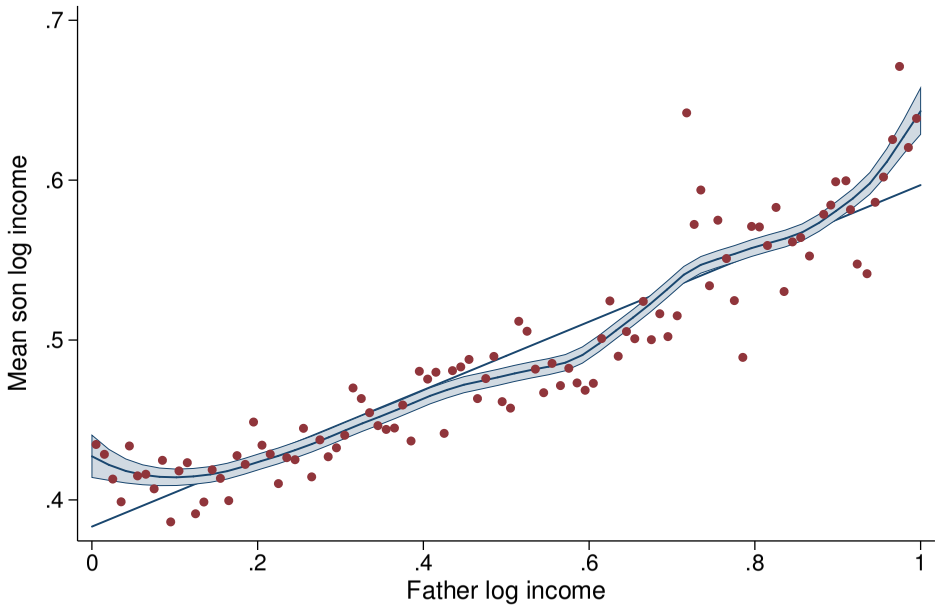


Figure A7: Son's income at 35 on father's imputed income

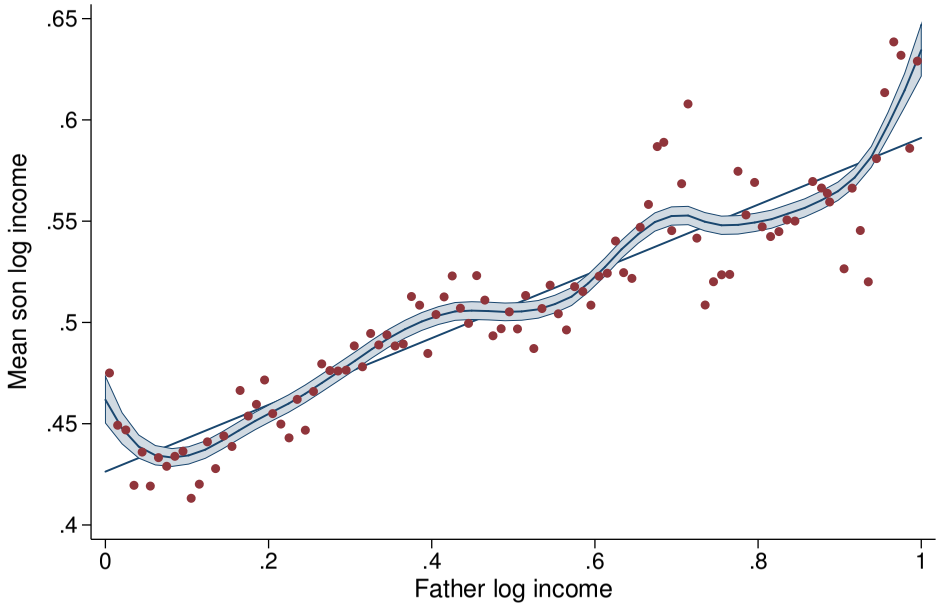
(a) 1932–33



(b) 1935–39



(c) 1940–44



(d) 1945–49

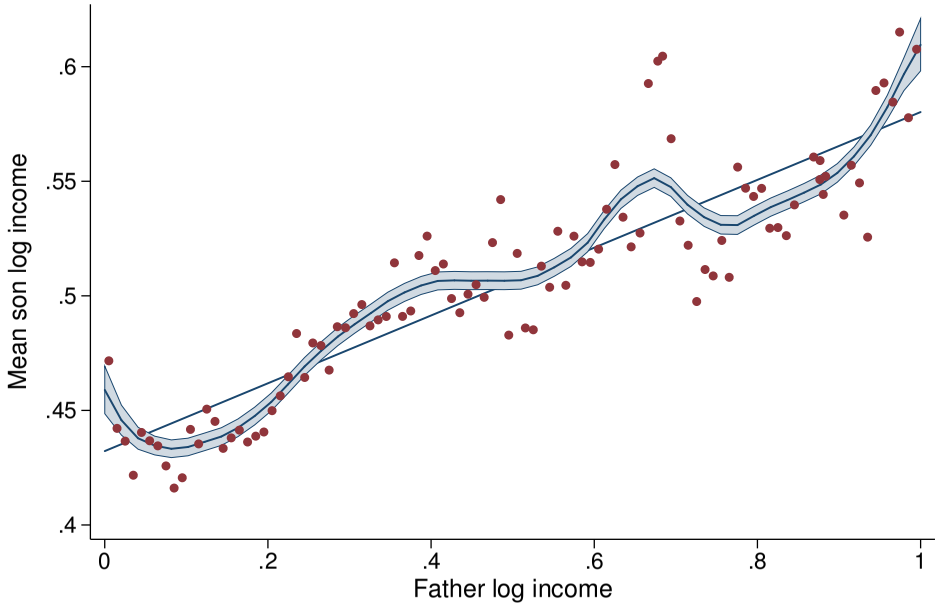
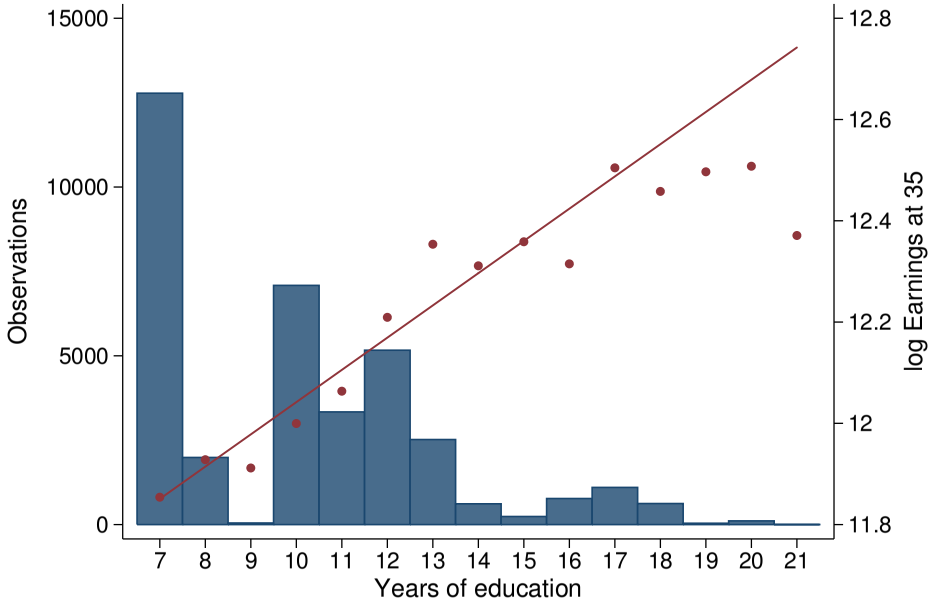
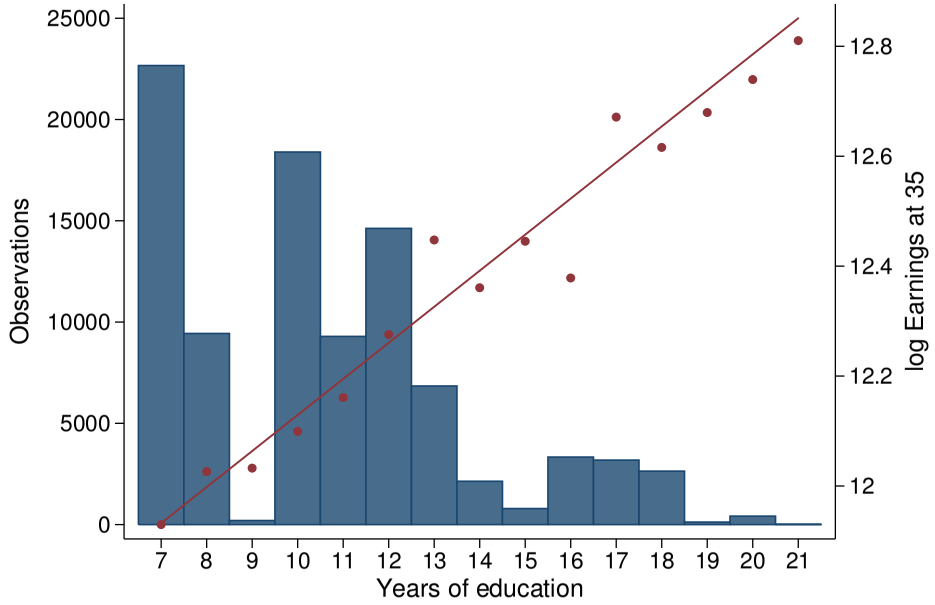


Figure A8: Log earnings and years of education

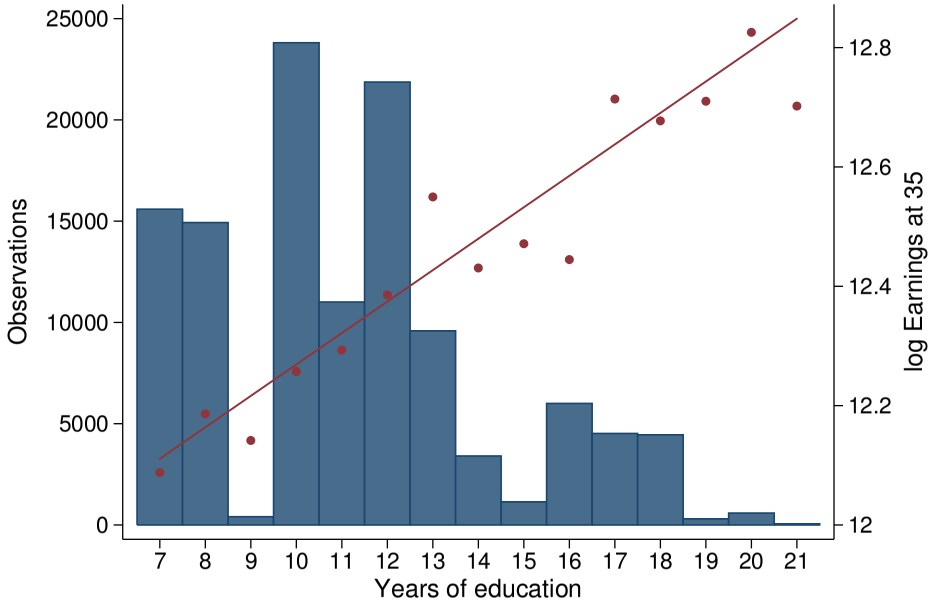
(a) 1932–33



(b) 1935–39



(c) 1940–44



(d) 1945–49

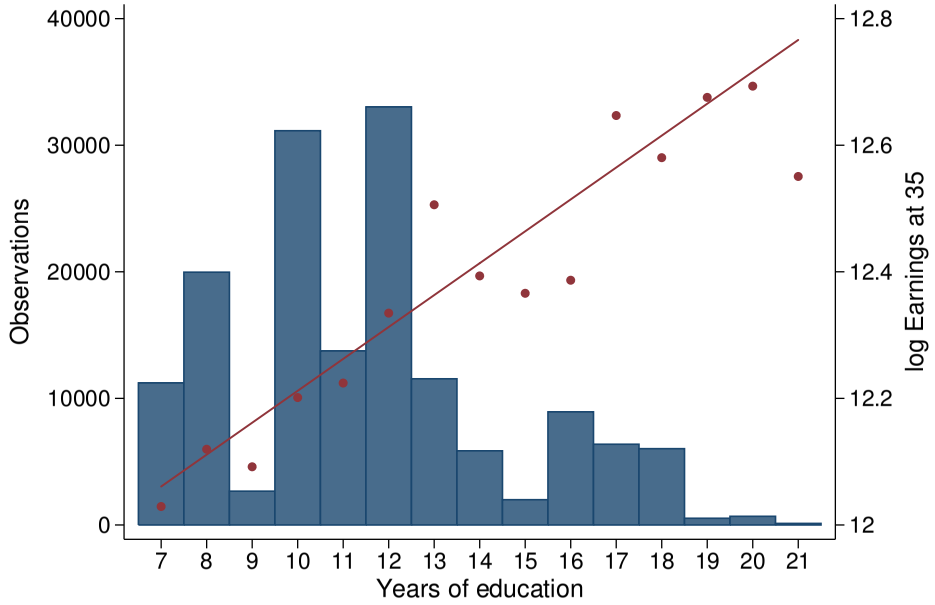
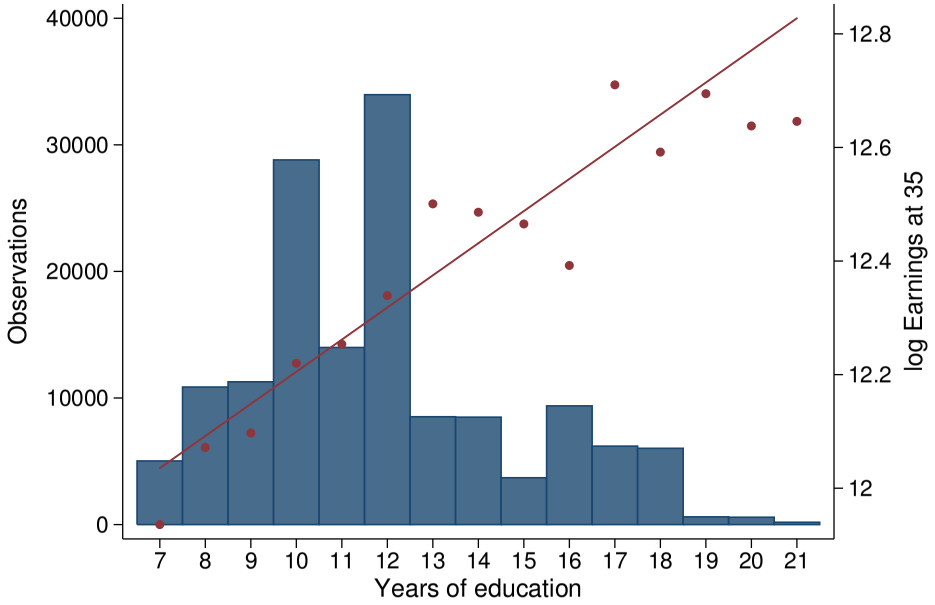
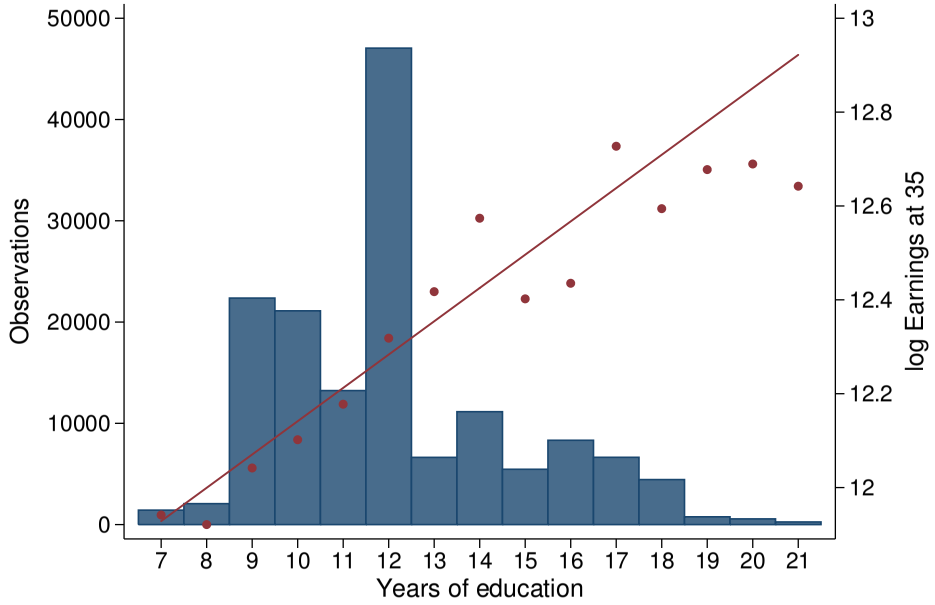


Figure A8: (con't) Log earnings and years of education

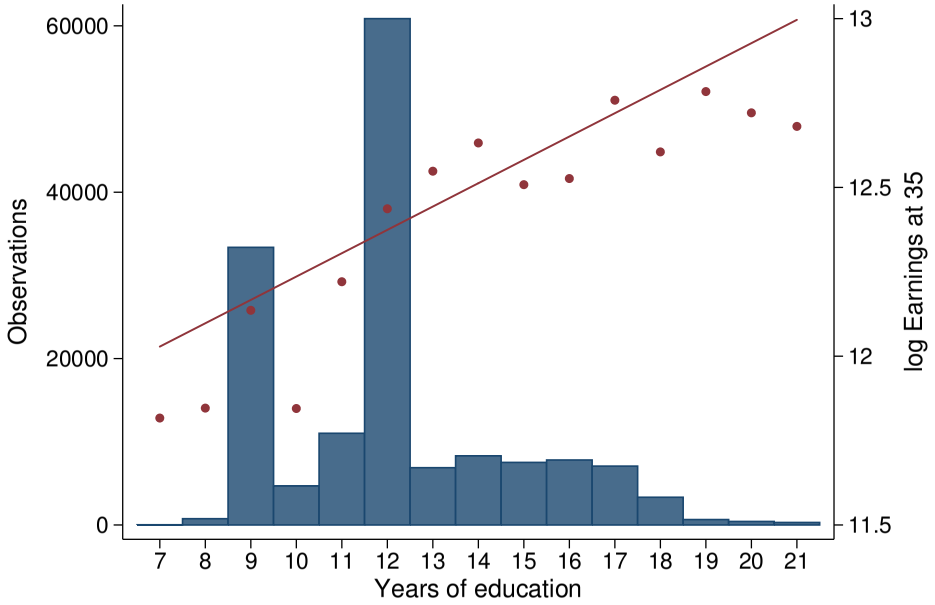
(e) 1950–54



(f) 1955–59



(g) 1960–64



(h) 1965–69