The Role of Education in Long-run Earnings Inequality and Mobility

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Abstract

This paper uses survey-linked administrative earnings data to explore whether increases in cross-sectional earnings inequality since 1980 have translated into increasing long-run earnings inequality and declining intragenerational mobility, and to what extent changes in the distribution of education among workers drives these trends. We estimate trends in cross-sectional residual earnings inequality, long-run residual earnings inequality, and long-run residual earnings mobility since 1980 and estimate how inequality and mobility differ across education groups. We use a kernel reweighting method to assess the impact of the skills by gender composition on these trends. Consistent with other work, we find that cross-sectional residual earnings inequality increased for men but decreased for women. However, long-run within-group earnings inequality rose for both men and women. As long-run earnings inequality grew, intragenerational within-group earnings mobility fell. For men we find similarities in the level and trend in residual inequality and mobility across education groups and very little role for compositional change in explaining trends in long-run economic inequality and mobility. For women though, convergence in inequality across education groups, especially at the lower-tail of the earnings distribution, results in a role for compositional change which explains about 20% of the increase in inequality over the period.

1 Introduction

A key concern about growing cross-sectional inequality is whether it translates into growing inequality in longer-run outcomes and reduced economic mobility. These concerns apply

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both to growing inequality and declining mobility across generations as well as to growing lifetime earnings inequality and economic mobility over an individual's own lifetime. Over an individual's lifetime, the theoretical link between cross-sectional and long-run outcomes is clear. Cross-sectional earnings inequality can grow because of growth in permanent earnings inequality or because earnings have become more volatile year-to-year. Growth in permanent earnings inequality could manifest in less relative earnings mobility over an individual's lifetime as the rungs on the ladder of the permanent earnings distribution become farther apart.

Evidence suggests that the increase in cross-sectional inequality since 1950 was driven in part by increases in permanent earnings inequality.[1] Despite growing permanent earnings inequality, long-run earnings mobility was relatively stable between cohorts starting their career in the late 1950s and those starting their career in the early 1980s (Kopczuk, Saez, and Song, 2010). The evidence on long-run earnings mobility in the period after 1980 is quite mixed, with Acs and Zimmerman (2008); Auten and Gee (2009); Auten, Gee, and Turner (2013) showing stable or slightly increasing earnings mobility and Bradbury and Katz (2009) and Carr and Wiemers (2016) finding declining earnings mobility.

An important insight of the existing literature is that there is substantial heterogeneity in trends in longer-run earnings inequality and earnings mobility over an individual's lifetime. The literature using administrative data focuses mainly on gender differences and shows that, while lifetime earnings inequality grew within each gender group, the closing of the lifetime gender earnings gap was sufficiently large to yield flat trends in lifetime earnings inequality Guvenen et al. (2017). Similarly, the stable trend in long-run earnings mobility

[1] This literature is large. The foundational work, which relied largely on the PSID, argues that increases in inequality in the 1970s were largely transitory, with increases through the early 2000s driven equally by permanent and transitory inequality (Baker and Solon, 2003; Gottschalk and Moffitt, 2009; Gottschalk et al., 1994; Haider, 2001; Moffitt and Gottschalk, 2002, 2012). More recent work relying on administrative data sources has attributed most of the more recent increase in inequality to rising permanent inequality (Debacker et al., 2013; Kopczuk, Saez, and Song, 2010).

between 1950 and 1980 was the result of growing mobility for women and declining mobility for men (Kopczuk, Saez, and Song, 2010).

There is also a strong focus in the wage inequality literature on the role that heterogeneity in inequality across education and gender groups plays in shaping cross-sectional trends and about the relative role of compositional change versus within-group trends in inequality in shaping trends in cross-sectional wage inequality (Goldin, Katz, and Kuziemko, 2006; Lemieux, 2006b). Understanding the role of differences in wage inequality across education groups has lead to key insights, including that rising wage inequality is due to skill and routine biased technological change that altered the relative return to particular skills, to changes in the supply of college educated workers, and to the increase in the relative shares of groups in the labor force who tend to have higher within group inequality (Autor, Katz, and Kearney, 2008; Lemieux, 2006a,b). Recent evidence suggests that the growth in wage inequality since 2000 has been shaped more by rising wage inequality among college graduates – that is, by trends in residual wage inequality – than by an increase in the returns for a college degree (Autor, Goldin, and Katz, 2020).

Perhaps due to data limitations, less is know about differences in long-run trends in earnings inequality or mobility across education groups or about residual (within-group) inequality in longer-run outcomes. There are large gaps in total lifetime earnings between men (women) with a high school degree and those with a bachelors' degree – approximately \$1.13 million for men and \$792,000 for women (Tamborini, Kim, and Sakamoto, 2015). Moreover, returns to education account for 30% of the increase in permanent inequality between the 1970s and 1990s for men (Haider, 2001). However, we do not know whether the growth in lifetime earnings inequality for men (women) is due to increasing inequality between less- and more-educated men (women) or if inequality is growing within these groups. We also do not understand how the changing composition of the labor market in terms of education affects trends in long-run mobility or earnings inequality.

In this paper, we use survey-linked administrative data to document trends in cross-sectional residual earnings inequality, long-run residual earnings inequality, and intragenerational (or long-run) residual earnings mobility since 1980 and to estimate how inequality and mobility differ across education and gender groups. We then investigate the extent to which trends in long-run residual inequality and mobility are shaped by compositional change and heterogeneity in levels of within group inequality. To do so, we follow the wage inequality literature and use a kernel reweighting procedure, first developed in DiNardo, Fortin, and Lemieux (1996), to examine the importance of the changes in the relative shares of groups in the labor force to the overall trends in residual long-run inequality and mobility. Our use of survey-linked administrative data is crucial for these analyses because administrative earnings records are paired with self-reported educational attainment.

We find that cross-sectional residual earnings inequality increased for men but decreased for women. The differential trends are driven by a substantial decline in inequality at the bottom of the residual earnings distribution for women, while upper-tail residual inequality for men and women and lower-tail residual inequality for men rose. While cross-sectional residual inequality rose for men but fell for women, long-run within-group earnings inequality rose for both men and women. These results underscore the importance of declining transitory earnings fluctuations for women in the estimates of cross-sectional inequality. Long-run earnings mobility largely followed trends in long-run earnings inequality with mobility falling as permanent residual earnings inequality rose. Our analysis of residual inequality shows that the rise in inequality in long-run outcomes is not simply due to a growing divergence across education groups, rather, inequality in long-run outcomes is rising within education groups. Further, we show that compositional change plays only a modest role in explaining the increase in residual inequality in either the cross-section or in long-run earnings and virtually no role for compositional change in explaining trends in mobility.

This paper proceeds as follows: Section 2 describes the SIPP-linked administrative data;

Section 3 describes the methods we use to estimate trends in inequality and intragenerational mobility, and the samples used for these estimates; Section 3.5 describes how we estimate the role of compositional change in these trends; Section 4 describes our findings on trends in residual inequality and mobility drawing comparisons to existing literature; Section 5 shows the role that compositional change in the labor market had in shaping the trends we describe; and Section 6 concludes.

2 Data

The data for this project come from Survey of Income and Program Participation data linked to administrative earnings histories from the Detailed Earnings Records.[2] The SIPP is a nationally representative sample of the civilian noninstitutionalized population of the U.S. that began in 1984. There have been 14 SIPP panels since 1984 with each panel lasting between two and six years. Each panel draws a new nationally representative sample of 14,000 to 52,000 households. SIPP panels after 1990 include a small oversample of low-income geographic areas that increases the number of households in or near poverty by 15%-20% over what would be observed otherwise. In the SIPP-linked administrative data, each individual in a SIPP household (including both children and adults) in the 1984, and 1990-2008 SIPP panels are linked to the DER, which is co-maintained by the SSA and the IRS and contains administrative earnings histories. These administrative earnings records are linked prospectively and retrospectively and contain non top-coded earnings from 1978-

[2]This analysis was first performed using the SIPP Synthetic Beta (SSB) on the Synthetic Data Server housed at Cornell University which is funded by NSF Grant #SES-1042181. These data are public use and may be accessed by researchers outside secure Census facilities. For more information, visit https://www.census.gov/programs-surveys/sipp/methodology/sipp-synthetic-beta-data-product.html. Final results for this paper were obtained from a validation analysis conducted by Census Bureau staff using the SIPP Completed Gold Standard Files and the programs written by these authors and originally run on the SSB. The validation analysis does not imply endorsement by the Census Bureau of any methods, results, opinions, or views presented in this paper. See Benedetto, Stinson, and Abowd (2013) for more information on the creation of these data and how to access them.

2014.

We only use SIPP participants who can be successfully linked to their respective administrative earnings histories. In the panels from the 1980s and 1990s, the match rate was about 80%. In the 2001 panel, the match rate dropped to 47% because many SIPP participants refused to provide Social Security numbers. Beginning with the 2004 panel, the match rate increased to around 90% because individuals were no longer required to provide a Social Security number for their survey data to be linked to their DER records. Data for any given year come from pooling all panels together, so no individual year is affected by the lower match rate in the 2001 panel. Overall, in the pooled data, about 80% of our sample are successfully matched to their respective administrative earnings histories.

The measure of earnings in the DER that is linked to the SIPP includes total earnings from all FICA-covered and non-FICA covered jobs with a W-2 or Schedule C (self-employment) filing. W-2 earnings are the sum of amounts from Box 1 (Total Wages, Tips, and Bonuses) and Box 12 (earnings deferred to a 401(k) type account). Earnings are not top coded after 1978. These earnings histories are drawn from the same universe of earnings histories–the Master Earnings File–that is used in most other analyses of administrative data, though the sampling frame is potentially different as the SIPP-linked data reflect the sampling procedure of the SIPP.

The data also include demographic and human capital information from the SIPP survey for individuals who were considered in universe at the time of the SIPP panel. In addition to gender and age, we use five categories of self-reported educational attainment: less than high school, high school, some college including non-four-year degrees, bachelor's degree, and beyond a bachelor's degree. Because educational attainment is collected at the time of the SIPP panel, we follow the convention used in cross-sectional data and only use individuals who were at least 25 at the time of the SIPP survey.

3 Methods and Measures

In this paper we document trends in cross-sectional residual earnings inequality, inequality in long-run residual average earnings, and mobility in residual earnings over a 15-year period. We consider these measures because of their relationship to one another. Cross-sectional and long-run earnings inequality are related to one another by relative earnings mobility over the same time period. Long-run inequality will be smaller than annual cross-sectional inequality if individuals move up and down the distribution of annual earnings over longer periods. However, if there is no movement of individuals in the annual earnings distribution over consecutive years, then cross-sectional and long-run inequality will be equal. The extent of positional (or relative) mobility determines the extent to which cross-sectional inequality translates into long-run inequality.

3.1 Residual Earnings

In what follows, we examine inequality and mobility in residual earnings which are defined using a specification analogous to that used in Lemieux (2006a), which uses residuals from a gender-specific regression of log earnings on dummies for single-year age, five education categories ($<$ HS, HS, Some College, College Grad, $>$ College), and educational-attainment specific age-earnings profiles using a quartic in age. We also consider inequality and mobility in earnings (not earnings residuals) across gender by education groups.

3.2 Cross-sectional Inequality

We measure overall cross-sectional inequality in residual earnings and cross-sectional inequality in log earnings by gender and education subgroups. All estimates use a sample of individuals age 25 to 59 with earnings above the first percentile of positive earnings in the gender-specific cross-sectional earnings distribution in year t. Residual earnings are calculated after trimming the bottom of the earnings distribution at the first percentile.

We follow much of the recent literature on wage and income inequality and rely on differences in percentile points of the log earnings distribution to measure inequality. Specifically, we use the log 80/20 earnings ratio to measure overall inequality, the log 80/50 ratio to measure inequality in the upper tail of the earnings distribution, and the log 50/20 ratio to measure inequality in the lower tail of the earnings distribution. Although the data have sufficient density at the top of the earnings distribution to use higher percentile points, we do not believe they add additional insight in this case. The use of higher (lower) percentile points would show larger increases in inequality, but leave the qualitative conclusions unchanged.

3.3 Long-run Inequality

Long-run earnings are is defined as average earnings over the period $t-3$ to $t+15+3$. Individuals must be 25 to 59 in all years of the 21 year period, and have positive earnings in year t. No additional restrictions are placed on earnings outside of year t, though we again trim the sample at the first percentile of long-run average earnings separately by gender and t. For residual long-run earnings, we first average earnings, then trim the earnings distribution, then adjust for age and educational attainment separately by year and gender, using age in year t. This allows for the inclusion of zero earnings in the long-run residual average outside of year t.

We measure log-run residual inequality and long-run inequality in log earnings by gender and education using differences in percentile points of the log earnings distribution. We refer to our measure of long-run inequality as inequality in year t, because it corresponds to the the way in which we index mobility which is described next.

3.4 Mobility

For mobility, we define earnings deciles in year t $(t+15)$ by ranking all individuals in the sample in a given reference year t $(t+15)$ based on average earnings over the window $(t-3, t+3)$ (or $(t+15-3, t+15+3)$). Individuals must be 25 to 59 in all seven years, have positive earnings in year $t(t+15)$, and have average earnings in $t(t+15)$ over the first percentile of the distribution of seven-year average earnings, separately by gender. Residual mobility is estimated on the distribution of residual earnings, where seven-year average residual earnings are also estimated by first averaging earnings, then trimming the earnings distribution, then estimating residual earnings separately by gender and year.

Mobility reflects an individual's movement across the entire distribution of seven-year average earnings, including individuals across the entire age distribution, not just those for whom we can estimate mobility between t and $t+15$. For example, if $t = 1981$ and an individual is 30 years old, we examine the relationship between average earnings for that individual between ages 27-33 from years 1978 to 1984, and average earnings between ages 42-48 from years 1993 to 1999. Our data cover the period 1978 - 2014, and so our first cohort, the $t = 1981$ cohort, covers the starting years of 1978 to 1984 and ending years of 1993 to 1999. Our last cohort, the $t = 1996$ cohort, covers the starting years of 1993 to 1999 and ending years of 2005 to 2014.

We use a non-parametric measures of positional (relative) intergenerational mobility. Specifically, we estimate the probability that individual i remains within plus/minus one decile of the starting decile over a 15 year period, as given in equation 1

$$M_t = \sum_{p=1}^{10} \left[\frac{\sum_{i=1}^{n} \mathbf{I_{it}} = \mathbf{1}\{\mathbf{d_{i,t+15}} \in [\mathbf{d_{it}} - \mathbf{1}, \mathbf{d_{it}} + \mathbf{1}] | \mathbf{d_{it}} = \mathbf{p}\}}{\sum_{i=1}^{n} \mathbf{D_{it}} = \mathbf{1}\{\mathbf{d_{it}} = \mathbf{p}\}} \right] \tag{1}$$

where $\mathbf{I_{it}}$ is an indicator for whether individual $i's$ earnings decile in $t+15$ is within plus/minus one decile of the starting earnings decile in t, summed over all n people who started in earnings decile p in time t. The numerator is the total number of individuals who are in earnings earnings decile p at time t, which is approximately the total sample size in t divided by 10. The result is a measure of persistence. This measure is analogous to measures of persistence that rely on the trace of the matrix, augmented to include in the measure of persistence small movements around the main diagonal of the matrix.

The fact that individuals are ranked in the full earnings distribution rather than that for whom we can estimate mobility means that an individual can move up (down) the earnings distribution over time either because earnings grow faster (slower) than other individuals of a similar age, or because new entrants to the labor force enter below (above) the individual over time. We rely on this approach because the effect of changes in permanent earnings inequality should play out across the entire earnings distribution, not just the distribution of a given age cohort.

The cohorts for which we have estimates of mobility are the same as the cohorts for which we have lifetime earnings estimates, but the samples are not identical. To estimate mobility, an individual must have positive earnings in years t and $t+15$. For long-run average earnings, an individual need only have earnings in year t. Earnings in all other years could be zero, as long as the average is above the first percentile of the long-run earnings distribution. In practice, this means that estimates of long-run inequality may include some individuals with more marginal labor force attachment than estimates of mobility.

3.5 Reweighting Inequality and Mobility

An important point of contention in the wage inequality literature is whether rising inequality reflects changes in how skills are rewarded in the labor market, or compositional changes in the labor market that "mechanically" increase inequality. While there remains debate in the literature on precisely how much of the rise in wage inequality is due to compositional change combined with faster increases in inequality among the college educated, there is a general consesus that both forces are at play Autor, Katz, and Kearney (2006, 2008); DiNardo, Fortin, and Lemieux (1996); Lemieux (2006a). A similar question applies to changes in long-run and short-run earnings inequality and to mobility. For example, as shown in Carr and Wiemers (2016), earnings mobility for the college educated is higher overall than for other levels of education, but has also been declining faster so changes over time in long-run mobility could simply reflect changes in the share of college-educated workers in the labor force.

Further, because mobility is estimated by ranking all individuals together, changes in the relative share of any given education group can have implications for mobility for the other education groups. For example, if part of the rising returns to education is driving by recent college graduates entering the labor force higher in the full earnings distribution, this will tend to decrease mobility of less educated workers both because this means that new entrants are increasingly like to enter low in the earnings distribution and because workers already in the labor force are pushed down the distribution by more educated individuals.

Following the literature on wage inequality, we employ a reweighting scheme to adjust estimated inequality and mobility for changes in the age by education composition through time. Described in more detail in DiNardo, Fortin, and Lemieux (1996); Lemieux (2006a), and employed in Autor, Katz, and Kearney (2008), the basic idea behind kernel reweighting is to hold one set of determinants of the earnings distribution fixed, and allow the other set to evolve as observed. In our case, we hold the earnings distribution fixed in a given base year, and allow the age by education distribution to evolve through time as observed. The result is a measure of how earnings inequality and mobility would have evolved if only the composition of the sample in terms of age and educational attainment changed through time. We refer to this as composition-adjusted, or counterfactual, trends in earnings inequality and mobility.

Comparison of composition-adjusted trends from different base years allows for the separation of the effect of compositional changes versus changing within group inequality or mobility. The key difference between the reweighting method employed here and previous methods is the reweighting of the earnings distribution rather than the wage distribution. Because of this, differences in levels or trends in inequality between different base years may reflect changes in either the wage or the work hours distribution. We will return to this issue later.

The observed density of earnings at time t is given in equation 2

$$f(e|T=t) = \int h(e|x, T=t)c(x|T=t) \tag{2}$$

where the overall earnings distribution $f(e|T=t)$ consists of two parts: the density of earnings conditional on characteristics x at time $T=t$ given by $h(e|x, T=t)$, and the density of characteristics x at time $T=t$ given by $c(x|T=t)$. As shown by DiNardo, Fortin, and Lemieux (1996), it is possible to create counterfactual earnings densities by applying the characteristics function $c(x|T=t')$ where $t \neq t'$ to the earnings distribution $h(e|x, T=t)$ to create a counterfactual earnings distribution for time $T=t'$ that represents the earnings distribution from t and the observed composition at t'.

The counterfactual characteristics distribution amounts to estimating the relative odds that an individual with a given set of characteristics x is present in a given year t' relative to some base year t, and using these odds to reweight the importance of similar individuals in all years aside from t. We use two base years: 1981 and 2011. DiNardo, Fortin, and Lemieux (1996) show that the reweighting function can be estimated using a logit regression, and derive weights given by equation 3

$$\frac{c(x|T=t')}{c(x|T=t)} = (1-T)\frac{Pr(T=t'|x)}{1-Pr(T=t'|x)} \times \frac{1-Pr(T=t')}{Pr(T=t')} + T \tag{3}$$

where $c(x|T=t)$ is the density of characteristics at time t, $c(x|T=t')$ is the (predicted) density of characteristics in the base year t', and the rest follows from Bayes's rule. Put simply, each year t is reweighted by the ratio of the predicted odds to the observed odds of an individual with characteristics x being observed in t'. That is, if we want to construct a counterfactual earnings distribution for 1982 that reflects what inequality would have been in 1982 if only composition had changed from 1981 to 1982, we take the observed distribution of earnings in 1981 and reweight those same individuals using the relative difference in the composition distribution between 1981 and 1982.

To estimate the logit regressions, we use a similar specification as in Lemieux (2006a), namely, a full set of age dummies, dummies for our five education categories ($<$ high school, high school grad, some college, college grad, advanced degree), and a set of interactions between a quartic in age and the education categories. The earnings distribution in year t is then reweighted to reflect the ratio of the predicted densities to the observed densities of the age by education distribution of the cohort. This is done separately by gender.

Mobility is then estimated using the observed and counterfactual earnings distribution, to obtain a measure of counterfactual mobility. However, reweighting mobility is somewhat more complicated than reweighting inequality, though follows a similar logic. In Equation 3, when $t = t'$, the observed and counterfactual inequality distributions are identical. This happens when reweighting inequality, either long- or short-run, because we are considering an earnings distribution from a "single" point in time. Mobility, on the other hand, involves the estimation of the joint distribution of earnings ranks at t and $t + 15$. This complicates the reweighting procedure because, between t and $t + 15$, both the $h(\cdot)$ and $c(\cdot)$ functions evolve.

To fix ideas, consider the estimate of mobility for the 1981 cohort between $t = 1981$ and $t = 1996$. Observed mobility for this cohort reflects changes in rank over the 15 year period, which is a combination of compositional change of the entire labor market, changes in inequality among all workers, and relative age-earnings profiles across the earnings distribution for the cohort. Ideally, to create a counterfactual estimate of mobility between 1981 and 1996 we would like to hold the earnings distribution fixed in 1981 and allow composition to evolve as observed between 1981 and 1996, and create a new estimate of mobility between 1981 and 1996. This is possible, in principle, as we can simply weight forward the 1981 earnings distribution using the 1996 composition distribution. The problem is that mobility is determined in ranks, and while this procedure alters which individual(s) represent a given earnings percentile, it preserves the relative position in the earnings distribution. Because mobility is estimated using ranks, this approach by construction results in essentially zero mobility because it rules out almost all changes in relative position in the earnings distribution.

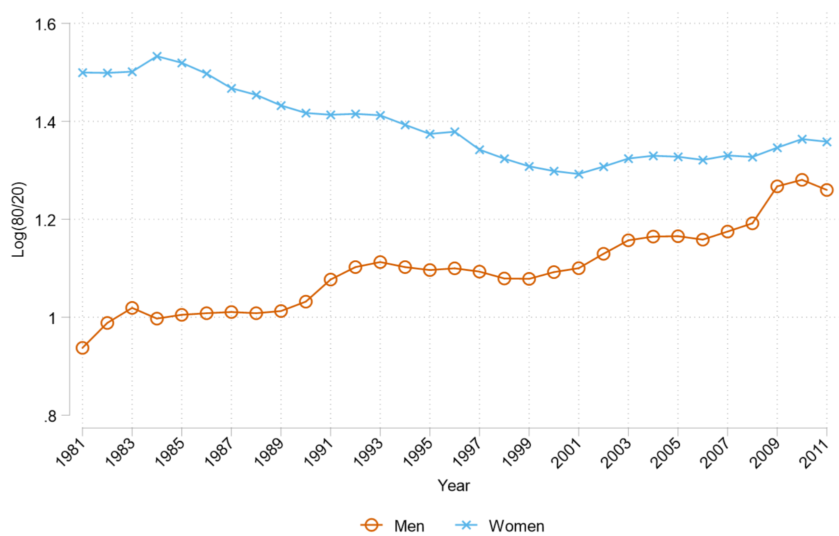
Instead, what we do is allow relative position to evolve as observed between 1981 and 1996, but remove the effect of compositional change that occurred between 1981 and 1996 from the estimate of mobility. In other words, counterfactual mobility for 1981 is estimated between the observed 1981 earnings distribution and the observed 1996 earnings distribution weighted back to the 1981 characteristics distribution. This means that inequality and relative position in the earnings distribution evolve as observed between 1981 and 1996 except for that which is due to compositional change between 1981 and 1996. As with inequality, counterfactual mobility for other years is estimated by fixing the cohort for which mobility is estimated (e.g. the 1981 cohort), and estimating a counterfactual level of mobility for this same group of individuals by applying compositional weights constructed using the difference in characteristics between these individuals and some other set of individuals in a different year. So, mobility between 1982 and 1997 takes the 1981 cohort, and weights 1981 forward to 1982, and 1996 back to 1982. Again, mobility evolves as observed over the working life of the 1981 cohort, but the cohort is reweighted to reflect the compositional characteristics of the 1982 cohort.

4 Results

4.1 Cross-Sectional Inequality

Figure 1 shows cross-sectional residual earnings inequality for men and women from 1981 through 2011, the first and last years for which we can estimate seven-year average earnings. Cross-sectional residual earnings inequality for men and women have followed opposite trajectories since the early 1980s with rising inequality for men and falling inequality for women. Residual earnings inequality increased by 35% between 1981 and 2011 for men but decreased by nearly 10% for women, though residual earnings inequality remained higher for women than men throughout the period.

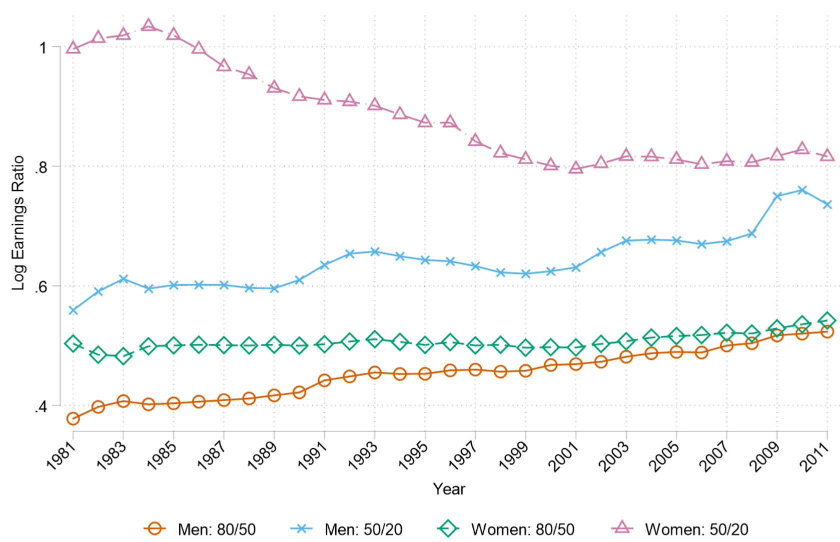
Figure 1: Cross-Sectional Residual Earnings Inequality by Gender



Notes: Author's calculations using SIPP linked administrative data from 1981 to 2011. Sample includes individuals with positive earnings above the first percentile of the cross-sectional earnings distribution between age 25 and 59. Earnings are adjusted for age and education separately by gender and year.

Figure 2 shows trends in upper- and lower-tail residual inequality for both men and women. For women, upper-tail residual inequality rose 6% between 1981 and 2011 while lower-tail residual inequality fell by 18%. These trends show that the decline in overall residual inequality for women is driven by falling inequality at the bottom of the earnings distribution. In contrast, residual earnings inequality for men rose by over 40% at both the lower-tail and upper-tail of the earnings distribution. Additionally, over the period, inequality converged for men and women in both the lower- and upper-tail of the earnings distribution. In 1981, lower-tail inequality was over 70% higher for women than men but was only 10% higher by 2011. Similarly, upper-tail inequality was 33% higher for women than men in 1981 but was only 2% higher in 2011. Figure 2 also shows that lower-tail residual earnings inequality is more cyclical for men than women with inequality rising during periods of recession.

Figure 2: Upper- and Lower-Tail Cross-Sectional Residual Earnings Inequality by Gender



Notes: Author's calculations using SIPP linked administrative data from 1981 to 2011. Sample includes individuals with positive earnings above the first percentile of the cross-sectional earnings distribution between age 25 and 59. Earnings are adjusted for age and education separately by gender and year.

The trends that we show in cross-sectional residual earnings inequality are consistent with trends in overall (non-residual) cross-sectional earnings inequality. Using administrative data, Kopczuk, Saez, and Song (2010) find rising upper-tail earnings inequality for both men and women, falling lower-tail earnings inequality for women, and rising lower-tail earnings inequality for men after 1970. Gottschalk and Danziger (2005) also find that total cross-sectional earnings inequality was falling for women and rising for men over the period. Consistent with what we show here, Gottschalk and Danziger (2005) and Haider (2001) show that hours are cyclical for men at the bottom of the earnings distribution which drives cyclicality in lower-tail earnings inequality but that hours inequality for women is much less cyclical.

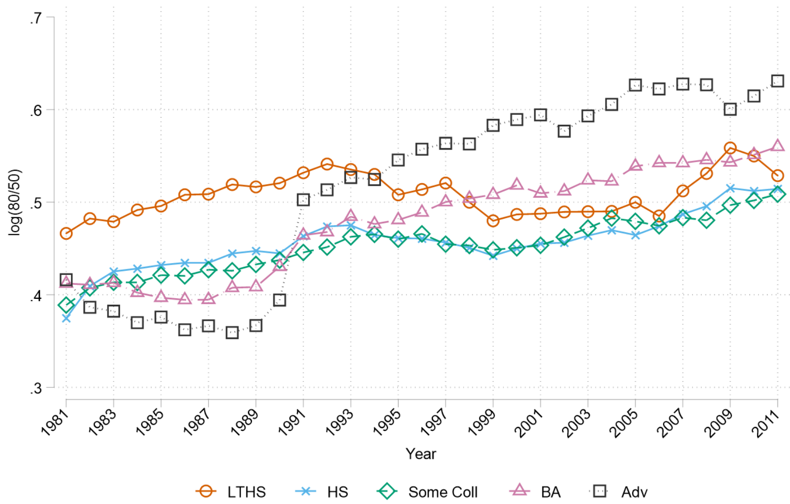
However, declining lower-tail earnings inequality for women contrasts with the wage inequality literature, which shows rising wage inequality overall and at both the upper- and lower-tail of the wage distribution (Autor, Katz, and Kearney, 2008). Gottschalk and Danziger (2005) show that large increases in hours worked by women after the 1970s decreased earnings inequality for women even while wage inequality increased. Similarly, our finding that residual lower-tail earnings inequality has increased for men contrasts with Autor, Katz, and Kearney (2008) who find only slowly increasing inequality in residual lower-tail wage inequality. Increases in inequality in hours and weeks worked for prime age men (Krueger, 2017) may explain the differences between trends in earnings and wages.

The trends in cross-sectional residual earnings inequality that we document, combined with the literature on overall cross-sectional earnings inequality, suggests that earnings inequality increased both between workers with different levels of education and experience but also within workers with the same levels of education and experience. To show how inequality evolved within each group, Figure 3 and 4 show trends in upper- and lower-tail earnings inequality by educational attainment for men and women respectively.

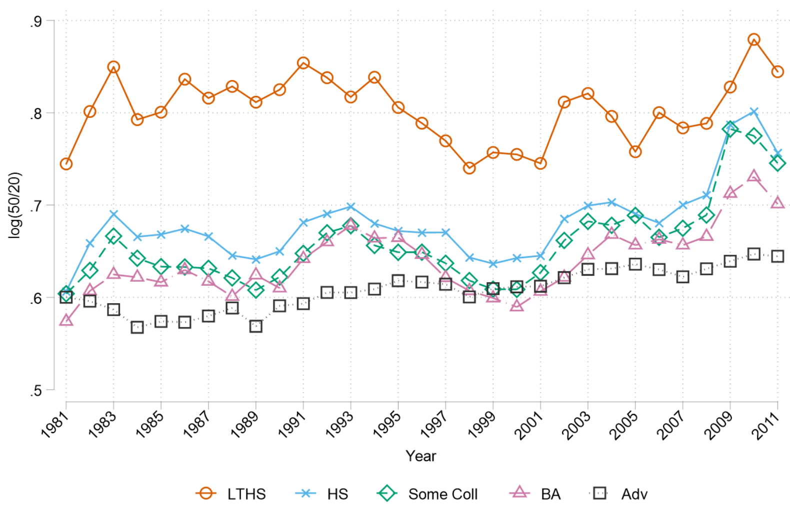
Upper-tail earnings inequality for men rose over the period across all levels of educational attainment except for workers with less than a high school degree where earnings inequality was stable. The increases in upper-tail inequality are largest for men with a college degree or more. In 1981, upper-tail inequality for men with a college degree was similar to that for men with a high school diploma or some college. By 2011, upper-tail inequality for men

Figure 3: Cross Sectional Earnings Inequality by Education: Men

(a) Log(P80/50)



(b) Log(P50/P20)



Notes: Author's calculations using SIPP linked administrative data from 1981 to 2011. Sample includes individuals with positive earnings above the first percentile of the cross-sectional earnings distribution between age 25 and 59.

with a college degree was 8% higher than for men with a high school diploma.

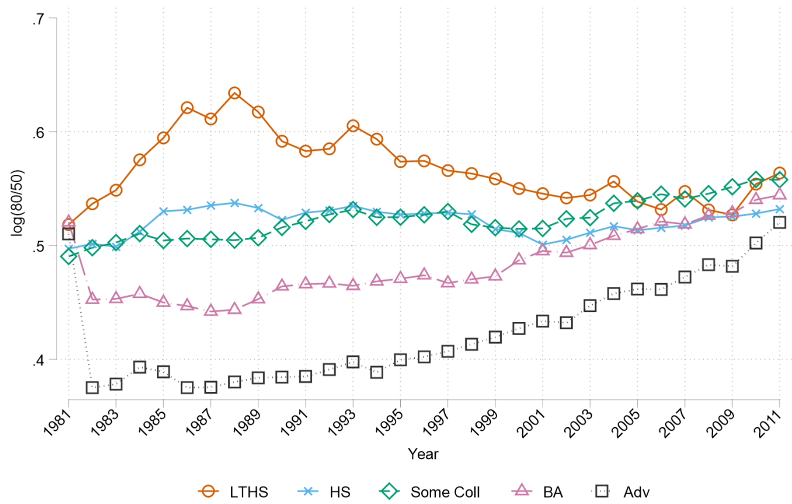
Notable though is the consistency in the rise in upper-tail inequality in the 1980s within groups of educational attainment and the similarity in the levels of inequality across groups. During the 1990s, though upper-tail inequality grew faster for college-educated workers, it also grew for workers with a high school diploma and some college. Lower-tail earnings inequality is quite similar for men who have a high school diploma, some college, and a college degree. All three groups have similar levels and trends in inequality and all three groups show the same cyclicality in lower-tail inequality that we noted in residual earnings inequality. Lower-tail earnings inequality is stable for men with less than a high school degree who have substantially higher levels of inequality that remain relatively flat over the period.

For women, there are much larger differences between groups both in the level and the trends in inequality. Upper-tail inequality is lower for more educated women and it grows more quickly, while it is smaller and increasing more slowly for women with a high school degree or some college. In contrast to men, levels of upper-tail earnings inequality become more similar between less and more educated women over the period. Lower-tail inequality falls for all women, regardless of their educational attainment, especially in the early period and is stable after 2000. The levels of lower-tail inequality across education groups also converge for women over time.

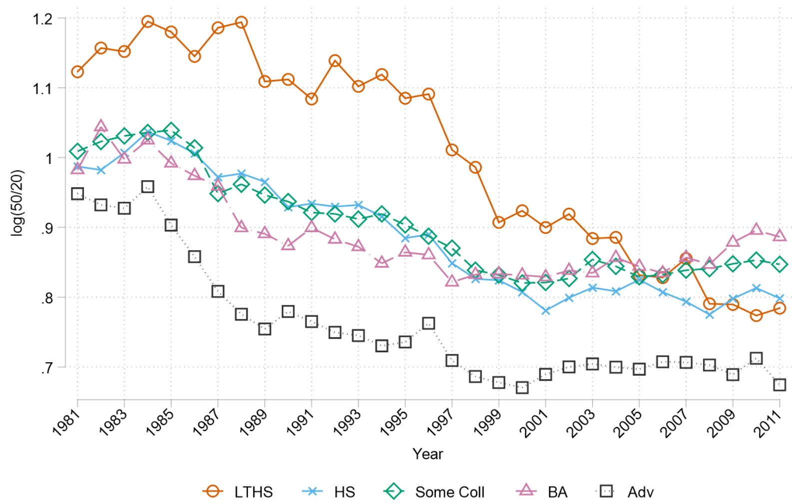
These trends in earnings inequality contrast somewhat with trends in wage inequality across educational groups. Lemieux (2006a) shows that the variance of wages diverges over time across educational attainment for both men and women. Wage inequality was relatively flat over the period for less educated men but rose for men with a college degree or more between 1973 and 2003 and wage inequality rose only for women with some college or more. These differential trends in wage inequality increased the differences in the level of cross-sectional wage inequality across groups over time (Lemieux, 2006a). In contrast, upper- and

Figure 4: Cross Sectional Earnings Inequality by Education: Women

(a) Log(P80/50)



(b) Log(P50/P20)



Notes: Author's calculations using SIPP linked administrative data from 1981 to 2011. Sample includes individuals with positive earnings above the first percentile of the cross-sectional earnings distribution between 25 and 59.

lower-tail earnings inequality increased for most levels of educational attainment for men for men but for women there was a convergence in earnings inequality across educational attainment groups. The differences between trends in wage and earnings inequality by educational attainment suggests that for men with less than a college degree, increases in inequality in hours and weeks worked led to increasing earnings inequality despite stable wage inequality. For women, declines in inequality in hours and weeks worked per year within groups served to reduce the differences in earnings inequality within groups even as wage inequality diverged within educational groups.

4.2 Long-Run Inequality

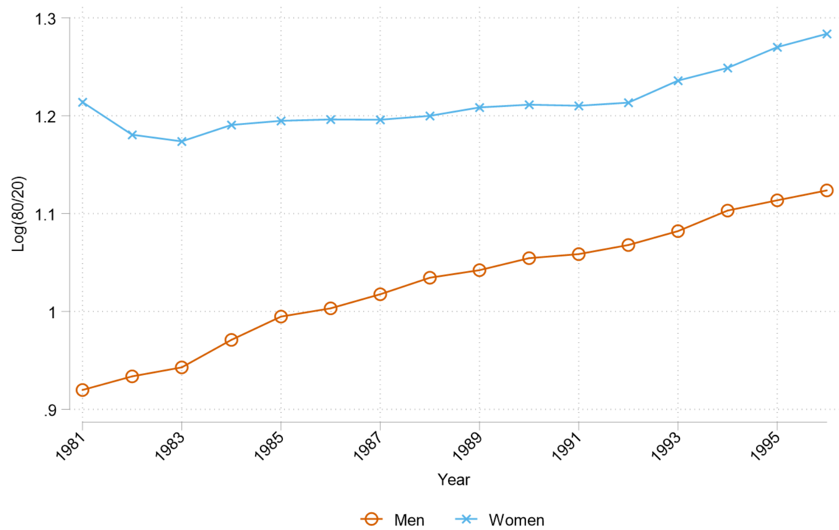
The trends that we estimate in cross-sectional within-group earnings inequality complement existing work on wage inequality, within-group earnings inequality, and total earning inequality and show that cross-sectional residual earnings inequality increased for men both at the top and bottom of the earnings distribution. For women residual earnings inequality declined because lower-tail earnings inequality declined, consistent with a decline in inequality in hours and weeks worked at the bottom of the earnings distribution. But, these cross-sectional trends tell us little about how within-group permanent earnings inequality and long-run earnings mobility evolved over the period. Changes over time in transitory earnings fluctuations affect cross-sectional earnings inequality and may mask long-run trends in permanent earnings inequality and long-run earnings mobility. Indeed, Ziliak, Hardy, and Bollinger (2011) shows that earnings instability declined substantially for women over the period which implies that trends in cross-sectional earnings inequality may diverge from trends in longer-run measures of earnings inequality and earnings mobility.

Figure 5 shows residual inequality in average earnings over a 21-year period for men and women. Long-run residual earnings inequality increased substantially between 1981 and 1996 for both men and women. For men, long-run residual earnings inequality increased 22% over the period and for women it increased about 6% though long-run residual earnings inequality for women is higher than that for men. For women, most of the increase came after 1990 but long-run residual earnings inequality for men increased steadily over the period.

Figure 6 shows trends in upper- and lower-tail residual long-run earnings inequality for men and women. In contrast to short-run measures of inequality, long-run within-group earnings inequality increased for men and women at both the top and bottom of the earnings distribution. Growth in lower-tail long-run residual earnings inequality for men was particularly dramatic, rising by nearly 24%. The differences between the short- and long-run trends for women suggest that the declines in transitory earnings instability over the period were large enough to mask growth in permanent within-group earnings inequality, particularly at the bottom of the earnings distribution. For men, increases in permanent earnings inequality are a large factor in explaining the growth in cross-sectional within-group earnings inequality. These findings complement those in Guvenen et al. (2017) who show increases in lower- and upper-tail non-residual lifetime earnings inequality for both men and women. Our findings show that within-group long-run earnings inequality also increased for both men and women in both the top and bottom of the earnings distribution.

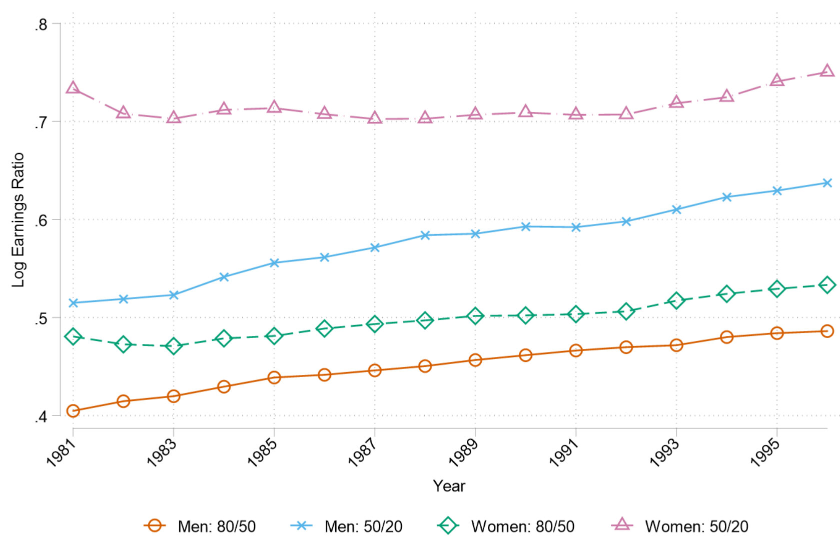
These SIPP linked administrative data also allow us to investigate whether these trends in within-group permanent earnings inequality come from similar or diverging trends in permanent earnings inquality across levels of educational attainment. Figure 7 and 8 show long-run earnings inequality across educational groups for men and women, respectively. For men, inequality grew over time within each educational group, with the exception of men with less than a high school degree. Upper-tail earnings inequality grew fastest for men with advanced degrees but rates of growth in inequality were similar for men with high school diplomas, some college, and a bachelor's degree. Across these educational attainment groups, the level of upper-tail permanent earnings inequality increases by educational attainment. Lower-tail permanent earnings inequality also increased for each educational group with

Figure 5: Overall Long-Run Residual Earnings Inequality by Gender



Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Sample includes individuals age 25 to 59 in year t with average earnings from $t-3$ to $t+15+3$ above the first percentile of average earnings and positive earnining in t. Average earnings are adjusted for age and education in year t, separately by year.

Figure 6: Top- and Bottom-End Long-Run Residual Earnings Inequality by Gender



Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Sample includes individuals age 25 to 59 in year t with average earnings from $t-3$ to $t+15+3$ above the first percentile of average earnings. Average earnings are adjusted for age and education in year t, separately by year.

smaller increases for those with less than a high school degree. Across educational attainment groups, lower-tail permanent earnings inequality for men evolved very similarly for each group.

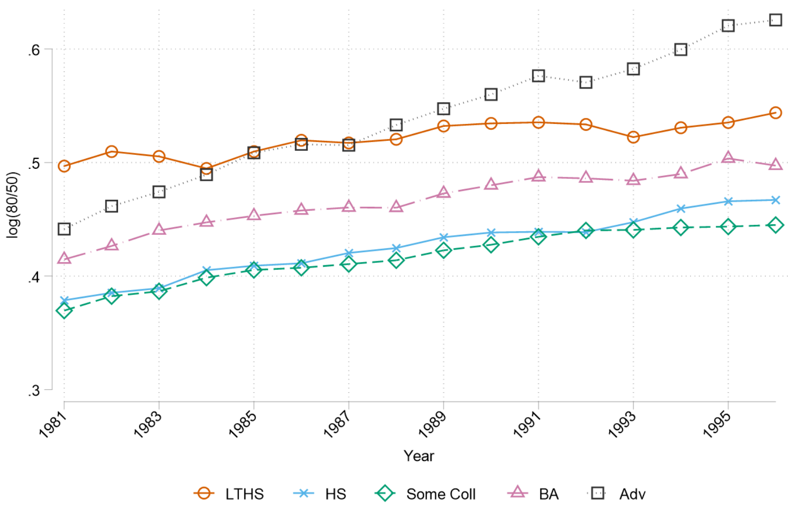
For women there is a greater contrast in trends in permanent earnings inequality across groups. Upper-tail earnings inequality grew most for women with advanced degrees and grew more modestly for other groups. Lower-tail earnings inequality was relatively flat for all groups until the 1990s when lower-tail permanent earnings inequality increased for all groups. In contrast to trends in cross-sectional inequality by educational group, lower-tail long-run earnings inequality did not fall for any groups and even increased slightly in more recent years. As with the trends in residual earnings inequality, this contrast between trends in cross-sectional and long-run earnings inequality by educational attainment group suggests large declines in the transitory earnings variance at the bottom of the earnings distribution are sufficiently large to allow cross-sectional earnings inequality to increase even as permanent inequality within groups rises.

Taken together, the trends in long-run versus short-run within-group inequality imply rising permanent inequality among both men and women with falling transitory earnings fluctuations for women. The increases in permanent within-group inequality are larger for men than women, but present for both. This is despite the fact that transitory instability is rising for men while it is falling for women (Ziliak, Hardy, and Bollinger, 2011). The trend in rising within-group permanent earnings inequality is present across most education groups, except for the least educated men and women, and in both upper- and lower-tail inequality.

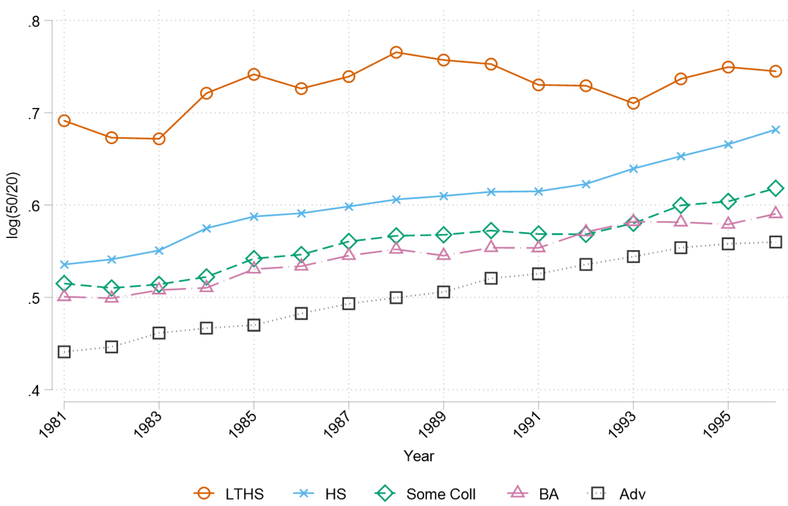
The growth in permanent within-group inequality that we document should imply that long-run earnings mobility is falling but, by necessity, long-run earnings inequality is measured on an age-based cohort so changes in long-run earnings inequality only reflect changes in the earnings distribution within the cohort and leave out the effect that new entrants to the labor market have on the evolution of earnings for individuals already in the labor

Figure 7: Long-Run Earnings Inequality by Education: Men

(a) Log(P80/50)



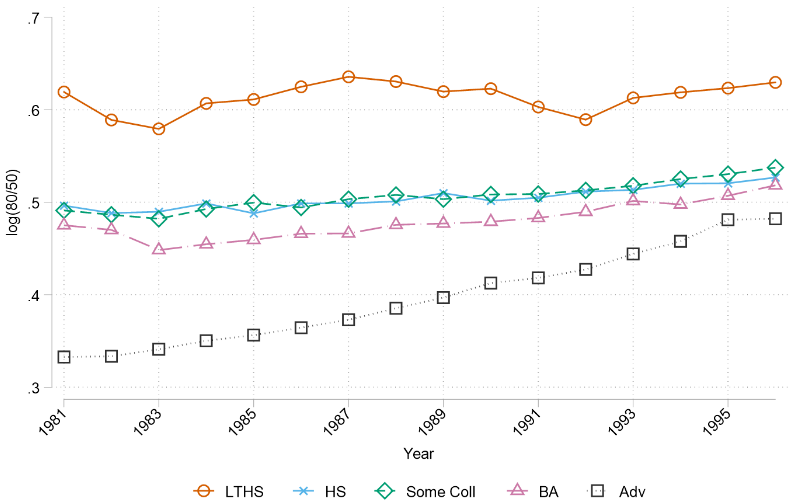
(b) Log(P50/P20)



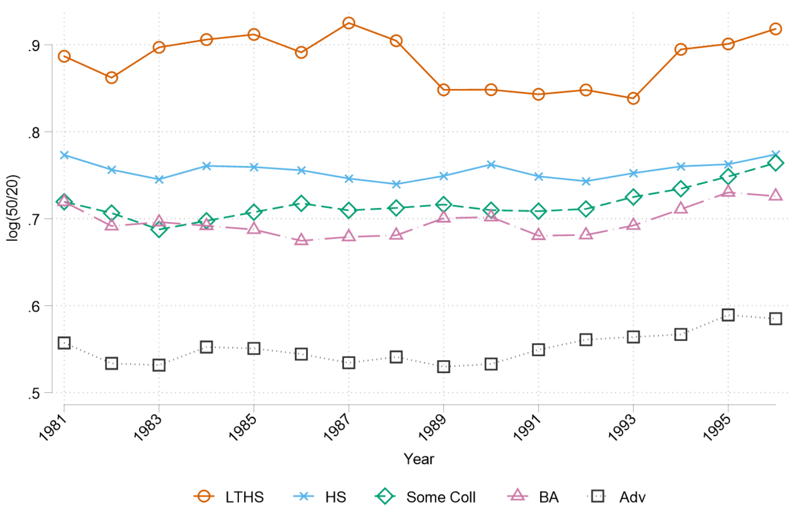
Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Sample includes individuals age 25 to 59 in year t with average earnings from $t-3$ to $t+15+3$ above the first percentile of average earnings.

Figure 8: Long-Run Earnings Inequality by Education: Women

(a) Log(P80/50)



(b) Log(P50/P20)



Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Sample includes individuals age 25 to 59 in year t with average earnings from $t-3$ to $t+15+3$ above the first percentile of average earnings.

market. We know that changes in inequality within the cohort are important both from our results and from Guvenen et al. (2017) who shows that rising total permanent earnings inequality for men is driven largely by growing inequality in initial earnings. But, a more complete understanding of permanent earnings inequality would also include the effect of changes in the cross-sectional earnings distribution due to new entrants to the labor market. To augment our understanding of the evolution of permanent differences between individuals, we now turn to trends in residual long-run earnings mobility, which allow for both change in inequality with the same cohort and also changes in inequality because of new entrants to the labor market.

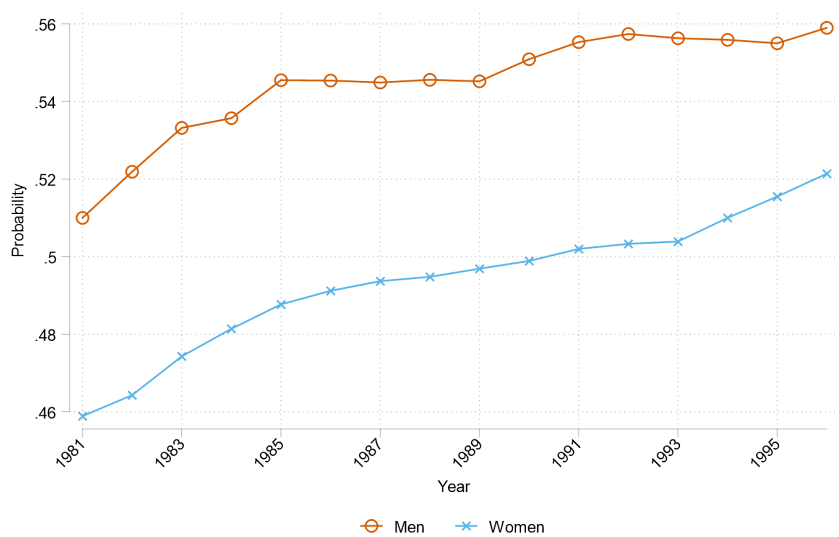
4.3 Mobility

Figure 9 shows trends over time in mobility over a 15-year period. We show a quite simple measure of persistence: the probability that one's residual seven-year average earnings decile in year $t+15$ is within one decile of one's seven-year average residual earnings decile in year t. Importantly, in both t and $t+15$ deciles are determined using the total seven-year average residual earnings distribution, taking into account that new entrants may enter the labor market at higher deciles than older workers.

Consistent with increasing inequality in long-run residual earnings, Figure 9 shows that residual earnings mobility has declined over time for both men and women. Men are 5 percentage points more likely to remain within one decile over a 15-year period and women are 6 percentage points more likely to do so, which corresponds to a 10% - 13% decline in mobility over the period between 1981 and 1996. Levels of mobility are higher for women than men, corresponding to a lower probability of remaining with one decile over a 15-year period.

Unlike long-run residual earnings inequality which declined for women only after 1991, mobility for women declined steadily over the entire period. Mobility declined most for men during the 1980s. These differences in trends in long-run inequality and mobility are suggestive of a pattern in which new female entrants to the labor market tended to start their career at a higher level than older workers, reducing mobility for older workers. For men, such a pattern of new entrants seems to have been strongest in the 1980s, during the period of rapidly rising returns to educational attainment, which would have benefitted young workers the most.

Figure 9: Probability of Remaining within One Decile in Residual Earnings by Gender



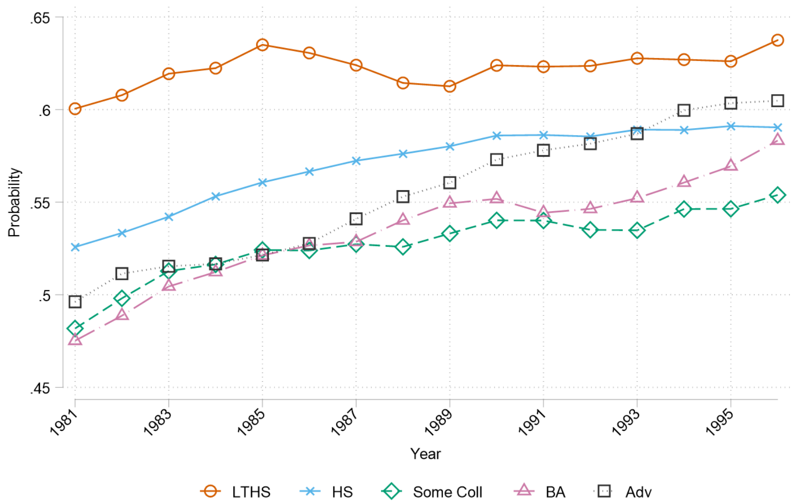
Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Mobility is defined as $Prob([d_{it}-1 < d_{i,t+15} < d_{it}+1]|d_t)$, or the probability an individual's starting and ending earnings decile are within $+/-$ one decile of each other. Mobility is estimated between average earnings in $t-3$ to $t+3$ and $t+15-3$ and $t+15+3$. Individuals must be 25 to 59 in all years, and are ranked against all 25 to 59 year olds in year t $(t+15)$ separately by gender. Average earnings are adjusted for age and education separately by gender and year.

We also examine trends in mobility within education groups shown in Figure 10. For men, the trends in earnings mobility across levels of educational attainment are consistent with the findings for long-run earnings inequality. For all groups except those with less than a college degree, earnings mobility declined with the steepest declines for the most educated workers. Carr and Wiemers (2016) show that declines in mobility for more educated groups are particularly steep because the probability of starting and staying in the highest decile has increased dramatically over time. For women, we see declines in long-run earnings mobility across all educational groups even though we did not see increases in permanent earnings inequality across all groups. If women entering the labor market do so at a higher rank over time, this would push down the rank of women already in the labor market which could lead to declining earnings mobility compared with the overall earnings distribution even if long-run earnings inequality within a cohort is growing more slowly.

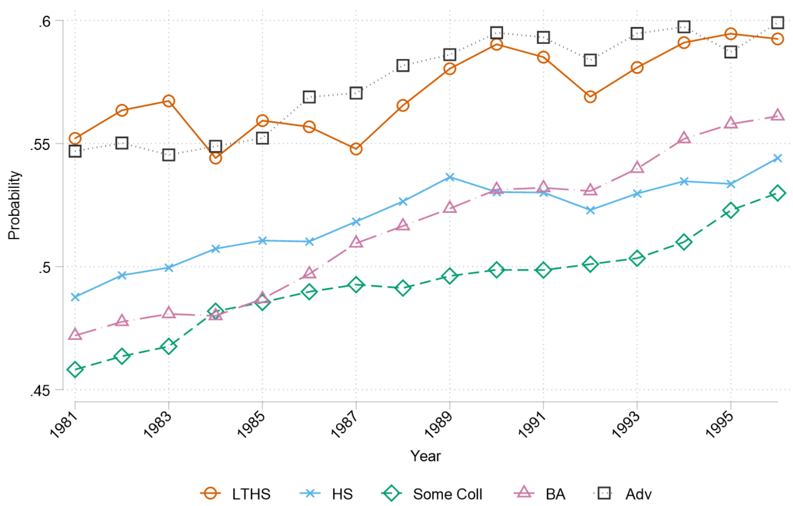
Taken together, the results for men indicate that what we learn from measuring residual earnings inequality in a single year largely bears out over a lifetime. Cross-sectional residual earnings inequality has increased along with long-run residual earnings inequality, and mobility has declined. These increases have happened at both the upper- and lower-tail of the earnings distribution. Except for workers with less than a high school degree, which has become a much more selective group over time, these same patterns play out within every educational group. For women, the picture is much more nuanced. Cross-sectional residual earnings inequality is falling. Yet, long-run residual earnings inequality is rising, particularly in the period after 1990, and long-run earnings mobility is declining steadily over time. These combined trends suggest that declines in transitory earnings instability are substantial for women, some of which likely comes from the rising stability of female labor supply. But, even as transitory earnings instability declined, permanent within-group earnings inequality has grown, particularly upper-tail inequality, and particularly for more-educated women. Within a cohort, the growth in within-group earnings inequality manifests in growth in long-run residual earnings inequality. Declines in mobility are also large, because new entrants to the labor market further reduce the mobility of older workers.

Figure 10: Probability of Remaining within One Decile in Earnings by Gender and Education

(a) Men



(b) Women



Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Individuals are ranked in the full distribution of unadjusted average earnings in t $(t + 15)$ seperately by gender, then mobility is estimated separately by education. See notes for Figure 9 for more details.

5 The Role of Composition

The trends we show in residual inequality and mobility and inequality and mobility within educational groups raises the question of the extent to which the trends that we see are simply the result of changes in the composition of these educational groups in the labor market over time or whether they are due to changes in the underlying distribution of earnings. To understand the role of compositional change, we construct a set of counterfactuals in which we hold the earnings distribution fixed in a given year and allow the age by education distribution to evolve as observed. By doing so, we can decompose the total change in inequality and mobility into that which is due to the size of each age and education group in the labor market and that which is due to the changes in the underlying distribution of earnings. In what follows, each figure reports both the observed trend in mobility (Observed), and the counterfactual trend $f(e|T = Y)$, which fixes the earnings distribution in year=Y and allows the age by education distribution to evolve as observed. We use $Y \in \{1981, 2011\}$ as counterfactual years. In each figure, the vertical distance in a given year t between observed and counterfactual mobility provides an estimate of the effect of changes in the composition constant earnings distribution. The trend through time of a given counterfactual trend (e.g. $f(e|T = 1981)$ shows the effect of compositional change on inequality or mobility.

Figures 11 and 12 show the observed and counterfactual trends in residual cross-sectional earnings inequality for men and women respectively. For men, we do not see any role for compositional change in explaining the increase in either upper- and lower-tail residual earnings inequality. If the earnings distribution were held fixed in 1981, the decline in the fraction of workers with less than a high school diploma, the group with the highest level of lower-tail inequality, would have caused a decline in lower-tail inequality throughout the period. A similar story applies to upper-tail inequality in the early prior. In contrast, inequality grew rapidly in both the upper- and lower-tail throughout the period indicating the importance of change in the distribution of earnings.

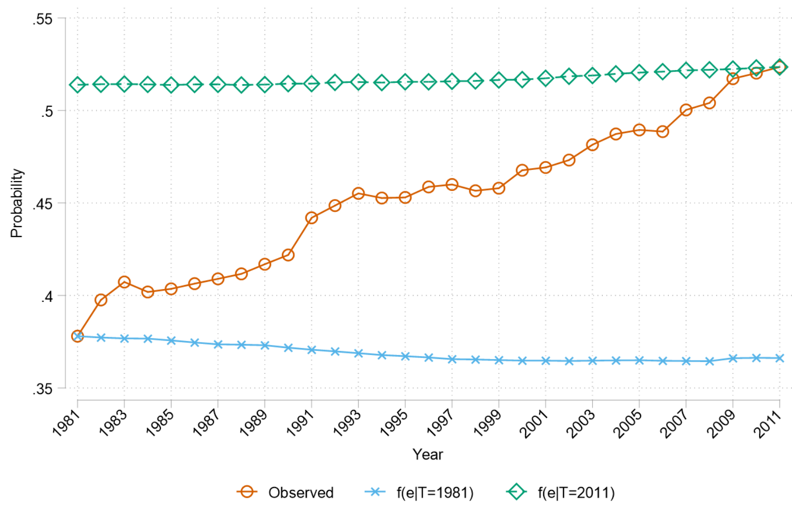
For women, there is some role for compositional change, particularly in lower-tail inequality. Approximately one-fifth of the total decline in lower-tail inequality for women is attributable to changes in the composition of the labor market. This is due to the increase over time in the fraction of women with an advanced degree and decline over time in the fraction of women with less than a high school diploma in the labor market as these groups have the lowest, and highest levels of lower-tail earnings inequality.

Figures 13 and 14 show the observed and counterfactual trends in residual long-run earnings inequality for men and women respectively. As in the cross-section, there is little role for compositional change in explaining the patterns of growing long-run residual inequality for men. The small role for composition is consistent with quite similar levels and trends of long-run residual inequality across groups. For women, we again see a role for compositional change, particularly in lower-tail inequality where about one-fifth of the increase in lower-tail long-run residual inequality is explained by compositional change.

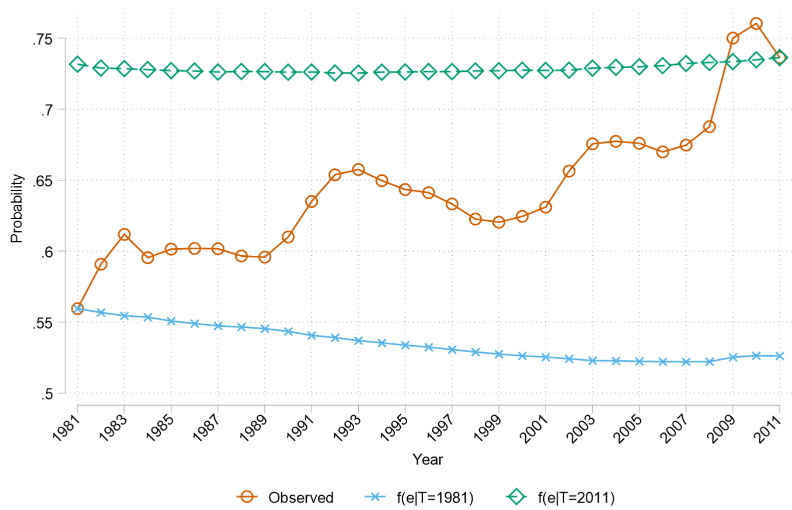
Finally, we consider mobility in Figure 15. For both men and women, we see little role of compositional change in explaining the change in long-run earnings mobility. Combined, the results on the role of compositional change suggest that changes in the earnings distribution were more important than changes in the composition of the labor force for explaining the trends in cross-sectional earnings inequality, long-run earnings inequality and long-run mobility for men. Compositional change explains about 20% of changes over time in lower-tail inequality both in cross-sectional residual earnings and in long-run residual earnings for women but little role in explaining changes in mobility.

Figure 11: Observed and Counterfactual Cross Sectional Residual Inequality: Men

(a) Log(P80/50)



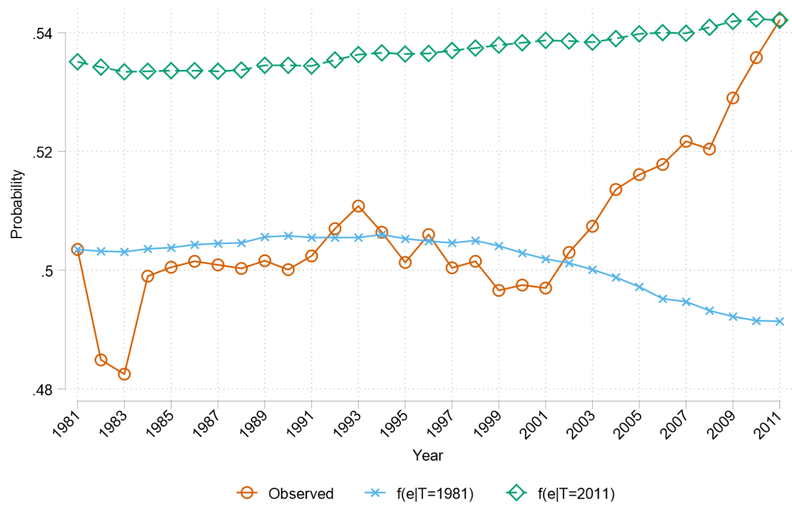
(b) Log(P50/20)



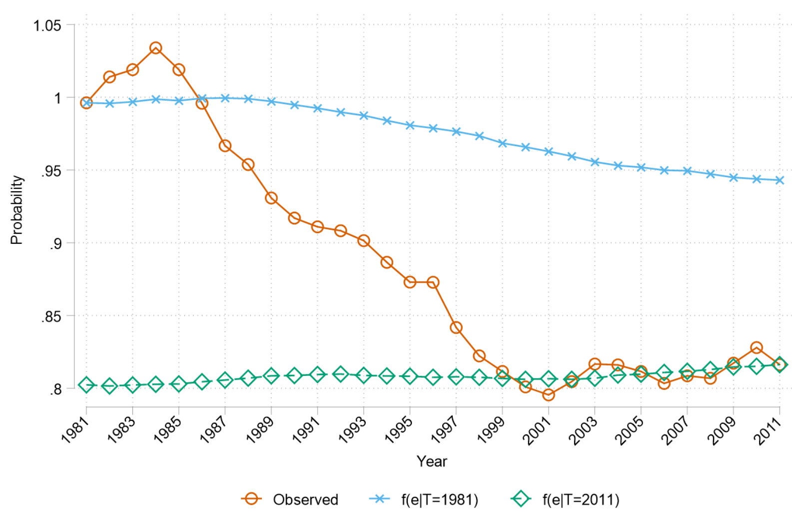
Notes: Author's calculations using SIPP linked administrative data from 1981 to 2011. Sample includes individuals with positive earnings above the first percentile of the cross-sectional earnings distribution between age 25 and 59. Earnings are adjusted for age and education separately by gender and year. f(e—T=Y) denotes counterfactual distributions based on the 1981 and 2011 earnings distributions, respectively.

Figure 12: Observed and Counterfactual Cross Sectional Residual Inequality: Women

(a) Log(P80/50)



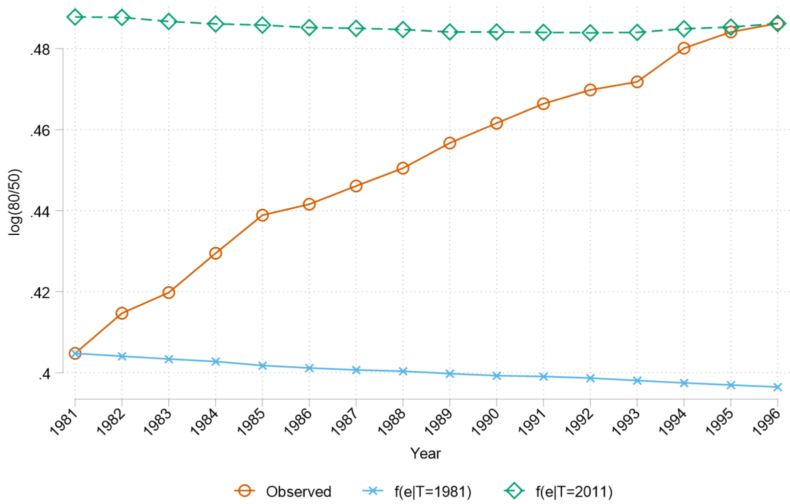
(b) Log(P50/20)



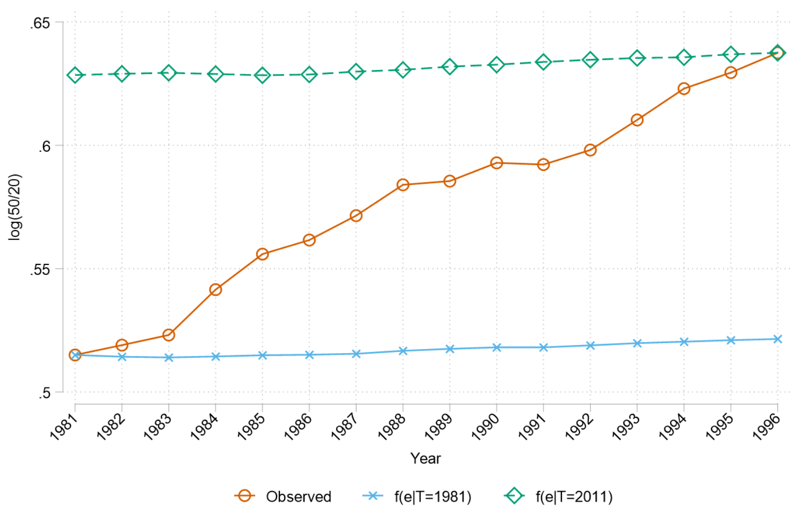
Notes: Author's calculations using SIPP linked administrative data from 1981 to 2011. See Figure 11 for more details.

Figure 13: Observed and Counterfactual Long-Run Residual Inequality: Men

(a) Log(P80/50)



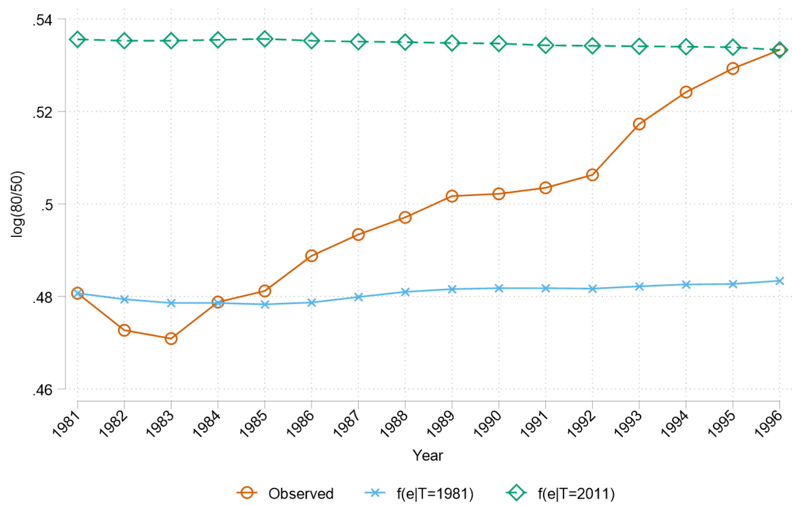
(b) Log(P50/20)



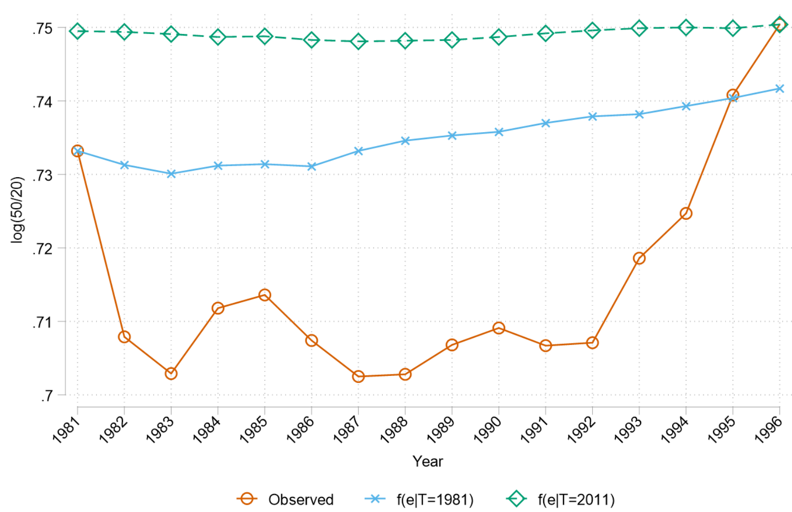
Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Sample includes individuals age 25 to 59 in year t with average earnings from $t-3$ to $t+15+3$ above the first percentile of average earnings and positive earnings in t. Average earnings are adjusted for age and education in year t, separately by year. f(e—T=Y) denotes counterfactual distributions based on the 1981 and 2011 earnings distributions, respectively.

Figure 14: Observed and Counterfactual Long-Run Residual Inequality: Women

(a) Log(P80/50)



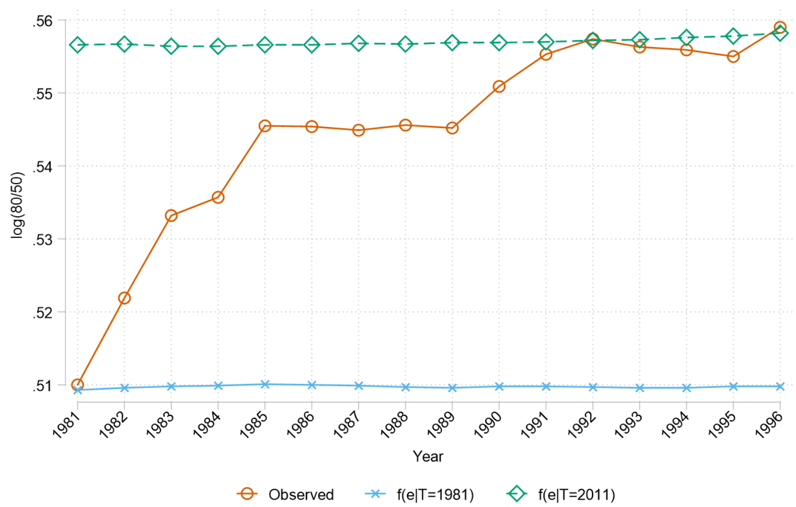
(b) Log(P50/20)



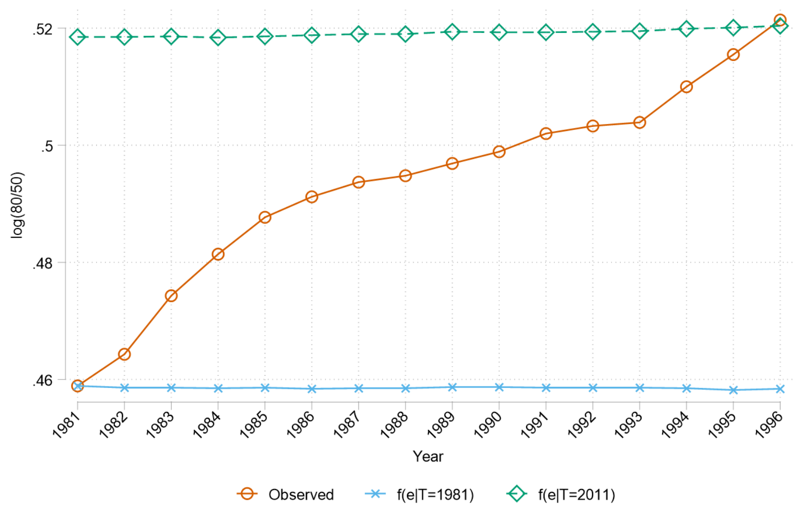
Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. See Figure 13 for more details.

Figure 15: Observed and Counterfactual Probability of Remaining within One Decile in Residual Earnings by Gender

(a) Men



(b) Women



Notes: Author's calculations using SIPP linked administrative data from 1978 to 2014. Individuals are ranked in the full distribution of unadjusted average earnings in t $(t + 15)$ seperately by gender, then mobility is estimated separately by education. See notes for Figure 9 for more details.

6 Conclusion

This paper uses administrative-linked survey data to document trends in cross-sectional and long-run residual earnings inequality and mobility since the 1980s and to understand the role of differences in trends across groups in shaping the overall trends that we find. The analysis complements the large existing literature on wage inequality but also the smaller literature on changes over time in the inequality of long-run economic outcomes and in intragenerational mobility. We find that for men, the story is quite simple. Residual inequality is increasing in the cross-section and in the long-run and it is increasing at both the upper- and lower-tail of the earnings distribution. As a consequence of growing permanent inequality, intragenerational earnings mobility is falling. Moreover inequality is increasing and mobility is declining across all groups of education, except those with less than a high school degree, and the trends across these groups are similar.

While the narrative about earnings inequality is consistent in the cross-section and in the long-run and is also consistent with declining mobility, the narrative diverges from trends in cross-sectional wage inequality, where wage inequality is growing faster for more highly educated men. Our results suggest that increases in inequality in hours and weeks worked, especially at the lower-tail, have increased earnings inequality for men with a high school degree even as wage inequality has remained relatively flat. The similarity in the trends and the levels of residual inequality and mobility across education groups for men leaves little room for compositional change in the labor market to play a large role in either short-run or long-run trends. Indeed, we find little evidence that compositional change was an important driver of increasing inequality for men.

For women, our results tell a very different narrative. Consistent with work on total (non-residual) inequality, we find declining cross-sectional residual earnings inequality for women which we show is driven by declines in lower-tail earnings inequality. Paired with rising wage inequality (Autor, Katz, and Kearney, 2008), this declining lower-tail inequality appears to be the result of declining inequality in hours and weeks worked, particularly at the bottom of the earnings distribution. But, despite declines in cross-sectional residual earnings inequality, long-run residual earnings inequality for women has grown, particularly upper-tail earnings inequality. The divergence between long- and short-run trends suggests that the decline in the transitory earnings variance for women is sufficiently large for cross-sectional inequality to decline despite diverging long-run economic outcomes. The increase in permanent inequality for women is also seen in declining earnings mobility which we see across all education groups.

Throughout, we see evidence that, as women's labor supply begins to increasingly resemble that of men, the inequality that women experience also has begun to mirror that of men. Levels of both long-run and cross-sectional residual earnings inequality have converged between men and women though inequality remains higher for women. Also in contrast to men, earnings inequality for women has converged across education groups, particularly in the cross-section. This leaves room for compositional change to play a role in growing inequality and declining mobility. We find that at the lower-tail, compositional change explains about 20% of the increase in inequality for women.

As a whole, we find increasing inequality in long-run earnings within education groups for both men and women. The growth in inequality in long-run earnings appears to translate into reductions in intragenerational mobility. The increase in long-run earnings inequality and the decline in earnings mobility is not restricted only to the most educated workers, instead this growth in inequality largely holds across all education groups. Moreover, changes in the composition of workers across the distribution of educational attainment does little to explain rising inequality in long-run earnings or declining intragenerational earnings mobility. These features point to further questions about the source of diverging patterns of earnings within educational groups. In particular, understanding the role that wages and both the extensive and intensive margin of labor supply play in these trends deserves closer attention.

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