Increasing Inequality in Parent Incomes and Children's Completed Schooling: Correlation or Causation?

Greg J. Duncan
University of California-Irvine
gduncan@uci.edu

Ariel Kalil
University of Chicago
a-kalil@uchicago.edu

Kathleen M. Ziol-Guest
Cornell University & Statistics Norway
kmz7@cornell.edu

March 30, 2013

Increasing Inequality in Parent Incomes and Children's Completed Schooling: Correlation or Causation?

Abstract

It is well known that income inequality increased dramatically in the United States beginning in the 1970s. Reardon (2011) documents a correspondingly large increase – of close to .50 standard deviations – in the test score gap between children in low and high income families over the same period. This paper shifts the focus from achievement to attainment, as measured by years of completed schooling, and tracks changes in income inequality and educational attainment between children born into low- and high-income households in the U.S. between 1954 and 1985. Using data from the Panel Study of Income Dynamics and concentrating on the cohorts whose adolescent family income were measured between the late 1960s and late 1990s, we find that the schooling gap between high and low income children grew by half a year (about one-quarter standard deviation). We attempt to account for the increase in the schooling gap by changing gaps in family income and other demographic factors (single parenthood, parent education, family size and age of mother at birth). We also estimate changes in the relative importance of income and these other demographic factors for children's completed schooling.

Across all 31 cohorts, we find that increases in the income gap between high and low income children account for about 70% of the increasing schooling gap. Shortening the accounting period reduces this estimate considerably. In contrast to Reardon (2011), we find no consistent evidence of increases in the estimated associations between parental income and completed schooling. Increasing gaps in the two-parent family structures of high and low income families accounted for relatively little of the schooling gap because our estimates of the (regression adjusted) associations between family structure and schooling were small. On the other hand, increasing gaps in the age of mother at the time of birth account for a substantial portion of the increasing schooling gap since mother's age is consistently predictive of children's completed schooling. In the case of parent education and family size, trends tended to favor low-income children and thus were unable to account for the increasing schooling gap.

Increasing Inequality in Parent Incomes and Children's Completed Schooling: Correlation or Causation?

Economic growth for much of the 20th century supported America's promise of offering opportunities to both parents and their children. In the thirty years between 1947 and 1977, a period in which gross national product (GDP) per capita doubled, the family incomes of those in the lowest income bracket nearly doubled as well.[1] In contrast, as documented in countless studies, the last 30 years have been marked by increasing income inequality, with stagnant incomes for families at the bottom of the distribution and sharp increases for those at the top of it.

Reardon (2011) explores the implications of this increasing income inequality for test score gaps between high and low income students. As described below, he finds that these gaps grew sharply, but also several reasons to doubt that the increasing gaps in income and test scores are causally linked. This paper shifts the focus from achievement to attainment, as measured by years of completed schooling, and tracks changes in income inequality and educational attainment between children born into low- and high-income households in the U.S. between 1954 and 1985. A key advantage of our efforts over Reardon's is that our data come from a single source – the Panel Study of Income Dynamics – which provides consistent, high-quality measures of income, enables us to link family income in adolescence to schooling completed a decade later and supplies measures of important family demographic conditions. We find that attainment gaps have grown, although not by as much as what Reardon (2011) found for achievement gaps.

Our primary goal is to account for the increase in the schooling gap with changing gaps in family income and other demographic factors (increasing single parenthood and parent education, falling family sizes, mother's age at birth). We also estimate changes in the relative importance of income and these other demographic factors for children's completed schooling.

BACKGROUND

How rising inequality may influence children's skills and attainment

Assessing how increased income inequality influences skill acquisition and educational attainment of children born into different circumstances is complicated. Duncan and Murnane (2011) present a conceptual model of how increasing family income inequality may affect access to high-quality child care, schools, and other settings that help build children's skills and educational attainments. Changes in these social contexts may in turn affect children's skill acquisition and educational attainments directly and indirectly through influences on how schools operate. For example, growing income inequality increases the gap in the resources rich and poor families can invest in their children (Kornrich and Furstenberg, 2012).

Growing disparities in parental investments may also indirectly widen skill gaps by contributing to residential segregation as the wealthy purchase housing in neighborhoods where less affluent families cannot afford to live. Indeed, residential segregation by income has increased in recent decades (Reardon and Bischoff, 2011). This can reduce interactions between rich and poor in schools, in child-care centers, in libraries, and in grocery stores. Without the financial and human resources and political clout of the wealthy, institutions in poorer neighborhoods, perhaps most importantly schools, may decline in quality, with detrimental effects on the education and life chances of children born into poor families (Altonji and Mansfield, 2011).

Similarly, low family income also makes it more difficult for parents to afford high-quality child care, which prepares children for kindergarten. It can also lead to difficult-to-teach classrooms filled with low-achieving, inattentive classmates. Crime in low-income neighborhoods may provide tempting alternatives to working hard at school and at the same time make it more difficult for neighborhood schools to recruit high-quality teachers.

Empirical evidence on how the relationship between family income and children's participation in these settings has changed over time is limited. What is known suggests that the rich have become richer in terms of the resources they spend on promoting their children's development. Kornrich and Furstenberg (2012) show that spending on child-enrichment goods and services jumped for families in the top quintiles but much less so for those in bottom income quintiles, as reflected in four large consumer expenditure surveys conducted between the early 1970s and 2005-2006. In 1972-1973, high-income families spent about $2,700 more per year on child enrichment than did low-income families. By 2005-2006, this gap had nearly tripled, to $7,500. Belley and Lochner (2007) compare the two cohorts of the NLSY (79 and 97) to show that high family income has become a substantially more important determinant of college attendance and college quality (but not high school completion) in recent years, particularly for those youth with the lowest skills. This, they argue, is consistent with the hypothesis that more youth are borrowing constrained today (given, e.g., rising tuition costs and falling Pell Grant offerings) than they were in the early 1980s.

In a related vein, Ramey and Ramey (2010) use time diary data to illustrate rising levels of time spent by parents on childcare in the U.S., especially for college-educated parents but in particular from the mid-1990's (i.e., considerably later in the period of rising income inequality).[2] College-educated mothers increased their childcare time by over nine hours per week, whereas less-educated mothers increased their childcare time by less than half that amount. The authors attribute part of this phenomenon to an increase in the perceived return to attending a good college. Similar socioeconomic differences in time spent in educationally enriching activities have been documented for children (Phillips, 2011). Thus, changes over time in parental time and capital investments are potentially plausible candidates for explaining divergence in children's actual attainments.

The rising number of children growing up in single-parent households might well be a powerful explanatory factor shaping the correlation between income inequality and children's outcomes (McLahanan and Percheski, 2008). For example, the proportion of children under the age of eighteen living in single-mother families rose from 10.9 percent in 1970 to 20.9 percent in 1985 to 22.4 percent in 2000 (Child Trends, 2011). This period corresponds to a sharp increase in the number of children born to an unmarried mother. The increase in single mother headed households has been greatest for those with the fewest economic advantages. In 1960, about 14% of mothers in the bottom quartile of the education distribution versus 4.5% of mother in the top quartile were single. By 2000, the percentages were approximately 43% and 7%, respectively. Thus, over four decades, the disparity in single motherhood by socio-economic background grew from 10 percentage points to 36 percentage points (McLanahan, 2004). This is important given that research has shown consistently that growing up in single-parent families is associated with negative consequences for children. For example, adolescents from single-parent homes are more likely to experience lower school achievement and aspirations, increased psychological distress, earlier initiation of substance use and sexual activity, and a greater likelihood of engaging in problem behaviors or deviant activities (McLahanan and Percheski, 2008; McLanahan and Sandefur, 1994).

Trends in maternal age at first birth have also changed in ways that may mitigate the adverse impacts of rising income inequality. For instance, the average age at first birth for mothers increased 3.6 years from 1970 to 2006, from 21.4 to 25.0 years (Matthews and Hamilton, 2009). Although Hispanic and non-Hispanic black women are younger on average at the time of first birth than their non-Hispanic white counterparts, increases in age at first birth since 1990 have occurred for women of all racial and Hispanic groups. Moreover, births to teenagers have been declining steadily over the past 50 years and have now reached historic lows in the U.S. (Martin, Hamilton, Ventura et al., 2012). Maternal age at childbirth appears to be a positive determinant of children's learning and educational attainment; financial independence from public programs such as welfare, food stamps, and Medicaid; (reduced) teen pregnancy; and adolescent and young adult problem behaviors such as fighting, truancy, and sexual activity; even after accounting for rich sets of covariates including maternal education, income, and race (Francesconi, 2007; Angrist and Lavy, 1996; Hoffman, 1998).

At the same time, other demographic trends in the US have changed in ways that may have partially offset the adverse impacts of rising income inequality. In particular, women's education levels have risen, they have increasingly delayed childbearing, and families have gotten smaller (Cherlin, 2005). With respect to education, undergraduate enrollment grew rapidly in the 1970's, especially for women. Correspondingly, the share of women age 25–34 with at least a college degree has more than tripled since 1968, from about 11 percent to about 35 percent (White House Council on Women and Girls, 2011). A higher share of women than men completed high school and earned a bachelor's degree in 2009 compared to 1971.

These trends are important because maternal education has a positive impact on children's development (Carneiro, Meghir, & Parey, 2007). One reason is that more years of parental education produces higher earnings and increased family incomes, which enables parents to purchase more resources for their children. Second, highly educated parents adopt different child socialization strategies than their less educated counterparts. They spend more time – and more "developmentally effective" time - with their children (Bianchi, Cohen, Raley, & Nomaguchi, 2004, Guryan, Hurst, & Kearney, 2008; Kalil, Ryan, & Corey, 2011), produce more cognitively stimulating home learning environments (Harris, Terrel & Allen, 1999), have higher expectations for their children's educational attainment (Davis-Kean 2005) and are more likely to adopt parenting strategies that promote achievement (Steinberg et al., 1992). Skills acquired through schooling may enhance parents' abilities to organize their daily routines and resources in a way that enables them to accomplish their parenting goals effectively (Michael, 1972).

Finally, families with large numbers of children have become less common, with a drop in the proportion of families containing four or more children from seventeen percent in 1970 to six percent in 2000, for example (Lofquist et al., 2012). Family size is inversely related to children's attainments (Price, 2010).

Our investigation of links between income inequality and children's schooling will account for concurrent trends in all four of these important demographic factors – single parenthood, maternal schooling, maternal age at birth, and family size. However, in the spirit of the Oaxaca (1973) decomposition framework, these other demographic factors will matter for increasing inequality in child outcomes only to the extent that their trends have favored higher- vs. low-income families and the factors themselves have important associations with child outcomes.

How has children's educational performance changed over time?

As the incomes of affluent and poor American families have diverged over the past three decades, so too has the educational performance of the children in these families. Reardon (2011) documents startling growth in the income-based gap on the test scores of children born since the 1950s. Among children born around 1950, test scores of low-income (10th income percentile) children lagged behind those of their better-off (90th income percentile) peers by a little over half a standard deviation, or about 50 points on an SAT-type test. Fifty years later, this gap was twice as large. Interestingly, the income-based gap grew despite the fact that racial gaps in test scores diminished during the same period (Reardon, 2011; Magnuson and Waldfogel, 2008).

Reardon (2011) explores the possible causal role rising income inequality may have played in generating the income-based test-score gap. He fails to find evidence that the growing income-achievement gap results from a growing achievement gap between children with highly and less-educated parents. But he also presents evidence that casts doubt on strong linkages between income inequality and test scores. For example, one would expect that if income inequality caused income-based test score inequality, then that relationship would hold in both the top and bottom halves of the income distribution. But he does not find that growing income gaps at the low end of the income distribution coincide with growing test scores gaps between low and middle-income children. Nor do trends in high-end income and test score gaps coincide. Moreover, he finds evidence that the gap has grown at least in part from the growing importance of income for children's achievement.

Using data from the 1979 and 1997 National Longitudinal Surveys of Youth, Bailey and Dynarski (2011) show that graduation rates for children born into high-income families jumped twenty-one percentage points (from 33 to 54 percent) between the early 1960s and the early 1980s. The corresponding increase for children born into low-income families was only four percentage points (from 5 to 9 percent). A little less than half of the gap between rich and poor in college graduation rates can be explained by differences in college enrollment rates, with the rest explained by differences in students' persistence in completing their degrees.

The goal of the present paper is to relate these secular changes in income inequality to changes in years of completed schooling over a three-decade-long period, the latter half of which spans the NLSY and NLS97 cohorts. In doing so, we add to the evidence produced by Reardon and by Bailey and Dynarski with a more thorough investigation of the associations between these two phenomena.

METHOD

Data

We use data spanning cohorts born between 1954 and 1985 from the Panel Study of Income Dynamics (PSID; (http://psidonline.isr.umich.edu)). The PSID has followed a nationally representative sample of families and their children from 1968 through 2009. Our analysis sample consists of 6,087 respondents who were observed in the PSID between ages 14 and 16 (the period over which we measure parental income and demographic variables) and had non-missing data on completed schooling around age 24. We adjust for differential non-response by using the PSID's attrition-adjusted weights in all of our analyses.

Completed education

We focus our analysis on a continuous measure representing years of completed schooling reported at age 24 (which, given our cohorts, is between 1978 and 2009). This measure has a value between one and 17, where one through 16 represents the highest grade or year of school completed. The PSID assigns a value of 17 for those who report at least some post-graduate work. Because the PSID switched to a biannual survey starting in 1997, for the even years 1998-2008 the year immediately previous or immediately following the year the respondent was 24 was used. Further, education values for heads and wives are not asked annually (as they are for other family members) because for adults it does not change quickly or commonly, so in some cases the most recent data available are also used. Periodically the PSID updates head/wife education, but in many cases earlier year education information is brought-forward to the current year survey.

Childhood income

We created a measure of average annual household income across the three calendar years when the child was 14-16 years old. We used the PSID's high-quality edited measure of annual total family income (pre-tax), which includes taxable income and cash transfers to all household members. Three-year average family incomes were inflated to 2010 levels using the U.S. consumer price index. Finally, income was truncated at the 1st and 99th percentiles to avoid undue influence from a handful of children with very large family incomes.

Control variables and regression procedures

We calculate associations between parental income and children's completed schooling both before and after adjusting for concurrent changes in key demographic correlates of income: the fraction of years between ages 14 and 16 that the child household contained only one parent; highest completed schooling of the household head when the child was 14 years old; number of siblings (born to the child's mother); age of the mother at the child's birth; child sex (female=1), race/ethnicity (Black and Hispanic), and whether the child was the mother's first born (yes=1). We run OLS regressions using STATA 12.0 MP, and all analyses were weighted using the PSID-provided attrition-adjusted weight. We test both linear and log regression specifications for associations between parental income and children's completed schooling.

RESULTS

Simple trends

We first sought to compare PSID information on income and schooling with Census data and data taken from the two youth cohorts in the National Longitudinal Studies of Youth. Appendix Figure 1 shows 10th, 50th and 90th percentiles of the distribution of child-based family income between 1968 and 1999 taken from the Current Population Survey.[3] Both sets of time series are child-based, although the CPS data are implicitly weighted by children of all ages, whereas PSID children were all age 14 at the time of the income measurement. Another difference is that we average trios of consecutive years in the PSID to remove some of its transitory error, and we center each of the 3-year averages on the middle years. In all cases, the income figures are inflated to 2010 dollars using the CPI.

Note first in Appendix Figure 1 that a child-based calculation of income trends in the Current Population Survey (and PSID) shows that the income gaps between the top and bottom of the income distribution were already increasing in the early 1970s, well before the point nearly 10 years later that marks the beginning of most accounts of the inequality increase. This has implications for how we think about using PSID cohorts to examine periods of increasing income inequality.

Turning to the comparative time series, Appendix Figure 1 show that incomes at all three points in the income distributions are higher in the PSID than CPS, which results in part from the older age of the PSID sample (all are age 14) relative to the CPS sample (children of all ages) and the fact that the PSID has always accounted for more aggregate income than the CPS (Fitzgerald et al., 1998). Our interest is in how well the two sets of time series track one another, particularly at the low and high ends of the income distribution. That appears to be the case, with the correlation between the two 90th percentile series at .78 and the 10th percentile correlation at .89. At .60, the correlation between the two time series of median income is somewhat lower.

Bailey and Dynarski (2011) present time series information on the relationship between childhood income and college completion. They use data from the NLSY79 and NLS97 to compare children in the top and bottom quartiles of the income distribution. They select children who began in these two studies between the ages of 14 and 19 and use parent family income measured in the first study year. They then measure completed schooling as of age 25. As described above, our PSID analysis tracks average income between ages 14 and 16 and completed schooling at age 24, which provides roughly comparable data on completed schooling by income. In both cases we measure college graduation rates.

Data from the two studies are shown in Appendix Figure 2. As might be expected from the fact that our use of 3-year average income quartiles likely excludes youth with transitory residence in the top and bottom income quintiles, PSID college graduation rates are a bit higher in the top quartile and lower in the bottom quartile than in the two NLS datasets. The striking increase in graduation rates for top-quartile youth tracks closely in the two data sources. For bottom quartile youth, the PSID's rates are somewhat flatter the NLS's. We have no ready explanation for this difference.[4]

The top panel of Appendix Table 1 shows correlations among 31-cohort average values of children's schooling and the five key demographic measures in our analysis. Parent education and income have the highest correlations with children's schooling. Among the family demographic measures, income and single-parent family structure are most highly correlation (r= -.528). The bottom panel shows that these correlations are broadly similar to those calculated over the most recent cohorts. An exception is that most of the correlations involving age of mother at the birth of the child have become stronger.

Turning to simple trends in high/low income gaps, we look first at our dependent variable -- children's completed schooling. In Figure 1 (with additional details in Appendix Table 2), we plot gaps between children in the top and bottom quintiles of the income distribution for all PSID cohorts and smoothed using lowess (based on line least-square smoothing and a bandwidth of

0.8). We also show lowess-based trends for data in the second half of the period, which corresponds roughly to the year covered by Bailey and Dynarski (2011).

Figure 1 shows relatively little change in the first third of the period, but an increasing gap across the late 1970s and 1980s, and then little change after that. As might be suspected from Appendix Figure 2, schooling gaps between the top and bottom quintiles are quite large. Top-quintile children who turned 14 in the first six years of the period enjoyed a 2.32 year advantage in completed schooling over corresponding children in the bottom quintile. This advantage increased by nearly half (.43) a year by the end of the period. Most of this increase occurred in the second half of the period – roughly the time covered in the Bailey and Dynarski (2011) study.

[Figure 1 about here]

Both absolute and relative income gaps grew as well (Figures 2-3). The gap in income for children in the top and bottom quintile of the income distribution s increased in the first part of the period, followed by a flat period and then ending with an increase. The average difference in incomes of children in the top and bottom quintiles was close to $100,000 in the first year of the period; this had grown to about $165,000 by the last year (Figure 2). About one-third of this increase occurred between the beginning and middle of our 31-year period. In the case of log income, a little more than half of the increase had occurred between the beginning and middle of the period. Juxtaposing the schooling and income trends in the first half of our accounting period presents one problem for an income-based explanation of changes in the schooling gap between high- and low-income children. Figure 1 shows that schooling gaps closed slightly, while at the same time income gaps were increasing.[5]

[Figures 2-3 about here]

Other large demographic changes were taking place as well, some of which favored high-income children and others favoring low-income children. Best known are the increases in single-parent family structures, which were particularly sharp among low-income children. In the first six years of the period, rates of single-parenthood for low-income youth averaged about 50% between ages 14 and 16. This increased to nearly 75% by the end of the period. The contrasting figures for high-income youth (3% and 6%) are much lower, and their increase was very small. As a result, the single-parenthood gap favoring higher-income children increased sharply over the period (Figure 4).

[Figure 4 about here]

Gaps in mothers' age at birth between low and high-income families increased as well. The average age of the mother at birth declined over the period for low-income children (from 27.9 to 24.7), whereas the average age increased for high-income children (from 27.4 to 28.7). These reinforcing trends produced a sharp increase in mother's age – from about 1.5 years early in the period to nearly 5 years at the end (Figure 5).

[Figure 5 about here]

Trends in parent education and family size favor low-income children. For example, parental schooling levels for higher income children increased from 13.3 to 15.1 years. Parent schooling levels for low-income children were much lower (7.9 and 10.7 years) but increased more rapidly, which accounts for the falling gap shown in Figure 6. And while family sizes are larger for low- relative to high-income families, the gap narrowed between the beginning and end of the period (Figure 6).

[Figure 6 and 7 about here]

Regression results

The ability of changes in parent income and schooling and of family structure and size to account for increases in schooling disparities between high- and low-income children also depends on the importance of these demographic factors in determining children's schooling. We do not pretend that our demographic regressions can pinpoint the causal impacts of these factors. But it is instructive to perform this kind of accounting and then speculate on the sensitivity of our estimates to possible biases in our estimates of importance.

Our schooling regressions are straightforward, using children's years of completed schooling as the dependent variable and, as independent variables: income, family structure and size (all averaged across ages 14-16), mother's age at the birth of the child, plus parent schooling, race, and Hispanic status and child gender and parity. We adjust standard errors to account for within-family clustering of siblings.

Regression results are summarize in Table 1 and detailed in Appendix Table 3. The first column presents regression results when all 31 cohorts are pooled together. Two versions of this regression are shown, one with parental family income entered linearly and the other using the natural logarithm of family income. Coefficients on the remaining variables are taken from the log income regression. Table 1 presents both raw-score and, in brackets, standardized coefficients.

[Table 1 here]

Consistent with abundant past literature, parental income and education are the most powerful predictors of children's schooling. In log form, each log unit increase in income is associated with a .64 year increase in children's schooling, while each additional year of parent schooling is associated with a .20 year schooling increase for their children. The standardized coefficients on these two measures are in the .2-.3 range. Additional siblings are associated with less schooling while mother's age is associated with more schooling (both standardized coefficients in the .15 to .20 range).

A surprise is seeing that, after adjusting for other variables, single-parent family structure does not have a statistically significant association with child schooling. As shown in Appendix Table 4, the bivariate coefficient on single-parent family structure, -.820, is much larger, statistically significant and has the expected negative sign.

Is income becoming a more powerful predictor of child attainment?

Part of the story we are investigating involves possible changes in the importance of our demographic measures, in particular family income, in explaining children's completed schooling. Perhaps, as Reardon (2011) suggests, the increasing income-based gaps in school success is caused more by an increase in the *importance* of income rather than an increase in the income gap itself. The second and third columns of Table 1 show results from regressions fit separately for children born in the first and second halves of the 31-year period. Most surprising is that there is no statistically significant increase in the explanatory power of family income; in fact, point estimates show a small decline. This appears to be at odds with Reardon's (2011) and Belley and Lochner's (2007) conclusions.

We explored these surprising results in a number of ways.[6] One possibility is that positive trends in income effects may have been accompanied by correlated trends in other demographic variables. Perhaps these other trends matter more than the income trend. In fact, the second and third columns of Table 1 show that the explanatory power of the other demographic measures did change much more markedly. The association between single-parent family structure and children's schooling changes from slightly positive to strongly negative. The importance of parent schooling increases as well, as does the association between the age of the mother and children's completed school. Associations between family size and completed schooling fall to nearly zero.

Still more detail on coefficient changes is shown in the last three columns of Table 1. Tracking changes from the early, middle and final years of the PSID, it shows no discernible trend in the income coefficients, family structure becoming important only for the latter cohorts, family size mattering only for the early cohorts, and the bulk of the increasing importance of parent schooling occurring in the early years of the observation period.

To explore trends based on all 31 cohorts, we estimated models in which the year the child turned age 14 was interacted with log income (Table 2). In the case of income, failing to adjust for trends in correlated demographic measures turns out to be crucial. When trends in other demographic measures are not controlled for, the trend in the coefficient on the interaction between log income and time is positive and statistically significant, implying a growth of .008 SD per year, a rate that would increase the income coefficient by about one-third across the 31 years. Controls for trends in the effects of the other demographic measures flip the sign of the income effect trend from positive to (insignificantly) negative. Thus, the increasing associations between income and children's schooling can be fully accounted for by trends (most notably an increasing importance of parental education) in the importance of correlated family measures.

[Table 2 here]

How important are other demographic measures?

We also examined linear trends in the association between the other four family measures and children's completed schooling. Since each of them may affect child outcomes through changes in family income, we calculated coefficient trends both before and after adjusting for trends in income effects. Figure 8 plots trends in the coefficient on parent education, single parent status, number of siblings, and age of mother before adjustments for trends in family income. To facilitate comparisons, all three measures are standardized. Figure 9 shows that parent education associations with children's schooling started the period quite large and have grown even stronger over time. Although associations with single-parent status have become more negative and associations with family size have become less negative, the size of these associations with children's completed schooling is much smaller than they are for parent education. The association with age of mother increased modestly over the period.

[Figure 8 about here]

Figure 9 shows coefficient trends when income trends are controlled as well. It is clear from the size of these lines that associations between completed schooling and both income and parent education matter the most. But it is also clear the relative importance of parent education and income has flipped over time, with the (standardized) log income/child schooling association stronger than parent education/ child schooling at the beginning of the period but considerably weaker by the end.

[Figure 9 about here]

Accounting for change

Our original intention was to perform a Oaxaca-type decomposition on links between income and schooling – how much of the divergence in schooling outcomes for high- and low-income children could be attributed to increases in the *amount* of income separating the two groups versus increases in the *importance* of income for completed schooling? It is clear from Table 1 and 2 that, at least according to the estimates coming from our simple demographic regressions fit to data from the PSID, parent income has not become more predictive of children's completed schooling over the past 31 years. In contrast, the explanatory power of other demographic variables (in particular parent education) has increased markedly.

As a result, we concentrate our accounting exercise on the first half of the Oaxaca approach, in which changes in gaps are valued by coefficients early in the time series. In fact, we choose two accounting periods – the first and last six years of the 31-year span provides the longest period over which changes could have taken place in our data, and the middle and last six years, which very roughly coincides with the period over which family income inequality has increased the most.

[Table 3 here]

The left panels of Table 3 and Figure 10 show the accounting for changes in the income-based gap in children's completed schooling between the first and last six years of our 31-year period. Over that time, the schooling gap between children in the top and bottom quintiles of the family income distribution increased by .43 years. The gap in average family income increased by $42,500. When valued by the .069 coefficient from the "All cohorts" regression in Table 1, the increasing income gap accounts for .29 years of the schooling gap, which is about 67% of the raw .43-year gap. The log form of the regression applied to differences in log incomes of the top and bottom quintile children yields a similar estimate – 74% of the gap accounted for.

[Figure 10 here]

Among the remaining demographic measures, only age of mother at the birth of the child accounted for a noteworthy positive amount of the increasing schooling gap. Recall from Figure 5 that the income-based gap in the age of the mother at the time the child was born increased sharly over the period. Moreover, age of mother was a quite significant predictor of children's completed schooling even after controlling for correlated family conditions. As a result, the increasing gap in mother's age at birth accounted for more than half of the increasing gap in children schooling.

Changes in the high/low income gaps in the other demographic variables mattered much less. Although single-parent families became much more prevalent among low than high-income families, its penalty for completed schooling for children was very small, leading family structure changes to account for almost none of the increasing schooling gap. Since parent education increased more rapidly for low- than high-income children, the considerable explanatory power of parent education for children's completed schooling leads us to expect it to narrow rather than widen completed schooling gaps. So too with family size, which fell more rapidly for low- than high-income families and were also a force for narrowing rather than widening the schooling gaps.

Changes since the early 1980s. As a robustness check, we estimated our accounting model across the period most associated with increasing income inequality, using the middle (age 14 in 1980-85) and final (age 14 in 1994-99) six-year cohorts. This is a period over which children's schooling gaps increased markedly (by half a year; Figure 1 and Appendix Table 1), as did gaps favoring high-income children in parent income, family structure, parent schooling, and age of mother (Figures 2-7 and Appendix Table 1). We use regression coefficients fit to data drawn from children turning 14 in the second half of our 31-year accounting period to value these gaps. The accounting picture for this period, shown in the right-hand panel of Figure 10, is quite different. Increasing income gaps are not nearly as dominant as before, accounting for between one-quarter and one-third of the increases in the schooling gap.

A look back to the trends in Figures 1 to 7 shows what is going on. The lowess trend line fit to the second half of the period shows even more of an increase in children's completed schooling than the trend line fit to the whole period (Figure 1). This means that there is as much change in the income-based children's schooling gap as before. Income equality increased in a roughly linear way, which means that changes in the income-based gap between low- and high-income children account for only about half as much of the increasing schooling gap as before. In contrast to the long-run narrowing of differences in parental schooling between children growing up in low- and high-income families, the lowess gap line fit to the second half of the PSID period increases rather than decreases (Figure 6). When coupled with the strong associations between parent education and children's schooling, this leads parent education to account for a noteworthy positive share of the increasing schooling gap between low- and high-income children.

Are adolescent-based measures of income and family structure misleading? One potential problem with our analysis is that our measures of income and family structure are drawn only from when the child was between the ages of 14 and 16. If these conditions are more consequential in other stages of childhood, then our adolescent-only measurement may be problematic for assessing associations with children's completed schooling. Although we lack whole-childhood information on children born before 1968, the PSID does provide it for cohorts born between 1968 and 1985 (and were therefore 14 in 1982 to 1999, which translates into the second half of the 31-year period), along with the same completed schooling information available for all cohorts.

Appendix Table 5 presents coefficients from analyses of the sample of children born between 1968 and 1985. Log income, family structure, parent schooling, family size, and age of mother are all standardized, although the schooling-based dependent variable is not. The first pair of columns shows that the age 14-16 income coefficient drops by half, from .95 to .47, in the presence of control variables. The third and fourth columns show that measuring (and then standardizing) income over the entire period of childhood increases its coefficient slightly – from .47 to .57. A look at the coefficient on single-parent family structure shows, if anything, a reduction in explanatory power in moving from an adolescent-based to a whole-childhood-based measure.

Given the possibility that income in different childhood stages matters differentially for children schooling, we also estimated a stage-specific version of the whole-childhood model.

Roughly speaking, coefficients on stage specific income components should sum to the whole-childhood coefficient. Using children's years of completed school as the dependent variable (fifth column), it appears that adolescent income matters the most, early-childhood income is next most important, and that income in middle childhood matters very little. A look at different levels of education shows that adolescent income is by far the strongest predictor of college graduation, while early and adolescent-based income are equally powerful predictors of high school graduation. Adolescence is the only period in which family structure is predictive.

Is the story different for boys than girls? Betrand and Pan (2012) provide the most convincing evidence that family structure matters more for boys, in particular African-American boys, than girls. We investigated gender differences in the regression coefficients and account shares on our income and family demographic measures in Appendix Table 6. Family structure is indeed more negatively related to completed schooling for boys than girls (difference significant at $p<.05$). None of the other coefficient differences are statistically significant at $p<.05$, and for the most part the accounting picture is not very different for boys and girls.

SUMMARY

We have used the 30+ year time series in the Panel Study of Income Dynamics to examine the evolution of income-based disparities in children's completed schooling in the United States. In line with the Bailey and Dynarski (2011) analysis of college graduation rates and Reardon's (2011) analysis of test scores, we find that gaps in the completed schooling of children in the top and bottom quintiles of the family income distribution increased by about half a year across the entire period, with virtually all of the increase occurring in the second half of the period. Our goal is to account for these increased schooling gaps changes with changes in the quantities and coefficients of income, parent education, family structure and size and age of mother at the birth of the child.

Consistent with Census data, gaps in both the absolute and relative incomes of 14-16 year old children in the top and bottom quintiles of the family income distribution grew sharply over the entire period; the gap in absolute income increased by $42,000 – more than 50%. But other big-ticket demographic changes were taking place at the same time. Rates of single-parent family structure increased much more for low- than higher-income families. Even more striking are trends in the age of the mother when the child was born, which increased for higher-income families but decreased for low-income families.

Parent schooling increased substantially for both groups, but faster for low- than higher-income children. Sibship size fell for both groups as well, again more for low- than high-income children. Each of these demographic factors is correlated with child achievement, but since our purpose is to account for growth in the income-based disparities in children's completed schooling, it is apparent that these disparate trends would complicate our task.

Attempts to account for increasing schooling gaps with changing gaps in demographic measures requires some sort of measure of the relative importance of the demographic measures in explaining children's schooling. Our regressions provided several surprises. First, single-parent family structure was not associated with less children's schooling until the second half of our accounting period. And second, income-based gaps in the age of mother at the birth of the child turned out to be surprisingly powerful in predicting income-based attainment gaps for children. Not surprisingly, family income and parent education turned out to be the most powerful predictors of children attainment.

Our accounting exercise showed that, using children who were adolescents between the late 1960s and late 1990s, increases in income inequality accounted for between two-thirds to three-quarters of the increasing schooling gaps between high and low income children. We found no consistent evidence that the importance of family income for children's completed schooling has increased over the past several decades, particularly after trends in the importance of correlated family factors (in particular parental education) are taken into account. On the other hand, the importance of an indicator of the quality (parent education level) of parenting and one of our indicators of the quantity (single-parent family structure) of parenting increased substantially over the period. Perhaps whatever gains in the technology of parenting that have occurred over the period are best captured by parenting activities.

References

Altonji, J and Mansfield, R. (2011). The role of family, school and neighborhood characteristics in inequality in education and labor market outcomes. In G. Duncan & R. Murnane (Eds.). *Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances* (pp. 339-358). New York: Russell Sage Foundation and Spencer Foundation.

Angrist, J. and Lavy, V. (1996). "The Effect of Teen Childbearing and Single Parenthood on Childhood Disabilities and Progress in School." NBER Working Paper No. 5807.

Bailey, M. and Dynarski, S. (2011). Inequality in Postsecondary Education. In G. Duncan and R. Murnane (Eds.). *Whither Opportunity: Rising Inequality, Schools, and Children's Life Chances*. New York: Russell Sage Foundation and Spencer Foundation.

Belley, P., and Lochner, L. (2007). The Changing Role of Family Income and Ability in Determining Educational Achievement. *Journal of Human Capital*, 1(1): 37-89.

Cherlin, A. (2005). American Marriage in the Early Twenty-First Century. *The Future of Children*, 15(2): 33-55.

Child Trends (2011). Births to Unmarried Women. Available at www.childtrendsdatabank.org/?q=node/196. Updated September 2012.

Child Trends (2006). Birth and Fertility Rates. Available at www.childtrendsdatabank.org/alphalist?q=node/232. Updated September 2012.

Davis-Kean, P. (2005). The influence of parent education and family income on child achievement: The indirect role of parental expectations and the home environment. *Journal of Family Psychology, 19,* 294-304

Duncan, G. and Magnuson, K. (2011). The Nature and Impact of Early Achievement Skills, Attention Skills, and Behavior Problems. In G. Duncan and R. Murnane (Eds.). *Whither Opportunity : Rising Inequality, Schools, and Children's Life Chances* (pp.47-69). New York: Russell Sage and Spencer Foundation.

Duncan, G. and Murnane, R. (Eds.). (2011). *Whither Opportunity: Rising Inequality, Schools, and Children's Life Chances,* New York: Russell Sage and Spencer Foundation.

Fitzgerald, J., Gottschalk, P., Moffitt, R. (1998). An analysis of sample attrition in panel data: The Michigan panel study of income dynamics. NBER technical working paper 0220.

Hertz, T., Jayasundera, T., Piraino, P., Selcuk, S., Smith, N., and Verashchagina, A. (2007). The inheritance of educational inequality: International comparisons and fifty-year trends. *The B.E. Journal of Economic Analysis & Policy* 7(2): 1-46.

Francesconi, M. (2007). "Adult Outcomes for Children of Teenage Mothers." IZA Discussion Paper No. 2778.

Guryan, J., Hurst, E., and Kearney, M. (2008). Parental Education and Parental Time with Children . *Journal of Economic Perspectives*, 22(3): 23–46.

Harris, Y.R., Terrel, D., and Allen, G. (1999). The influence of education context and beliefs on the teaching behavior of African American mothers. *Journal of Black Psychology*, 25, 490-503.

Hoffman, S. (2008). “Updating the Teen Miscarriage Experiment: Are the Effects of a Teen Birth Becoming More Negative?” Working Paper Series, Department of Economics, Alfred Lerner College of Business & Economics, University of Delaware, Working Paper No. 2008-08.

Hout, M. and Janus, J. (2011). Educational Mobility in the United States since the 1930s. In G. Duncan and R. Murnane (Eds.). *Whither Opportunity: Rising Inequality, Schools, and Children's Life Chances* (pp.165-186). New York: Russell Sage Foundation and Spencer Foundation.

Jencks, C., and Phillips, M.. (1998). *The black-white test score gap*. Washington, D.C.: Brookings Institution Press.

Kalil, A., Ryan, R., and Corey, M. (2012). Diverging destinies: Maternal education and investments in children. Forthcoming, *Demography*.

Kornrich, S., and Furstenberg, F. (2012). Investing in Children: Changes in Spending on Children, 1972 to 2007. Forthcoming, *Demography*.

Lofquist, D., Lugaila, T., O’Connell, M., Feliz, S. (2012). Households and Families: 2010. 2010 Census Briefs. U.S. Census Bureau.

Magnuson, K. and Waldfogel, J. (2008). *Steady Gains and Stalled Progress: Inequality and the Black-White Test Score Gap*. New York: Russell Sage.

Martin J., Hamilton B., Ventura S., et al. (2012) Births: Final data for 2010. National vital statistics reports; vol 61 no 1. Hyattsville, MD: National Center for Health Statistics. 2012.

Mathews T., & Hamilton B. (2009). Delayed childbearing: More women are having their first child later in life. NCHS data brief, no 21. Hyattsville, MD: National Center for Health Statistics. 2009.

McLanahan, S. (2004). Diverging Destinies: How Children Fare Under the Second Demographic Transition. *Demography*, 41(4): 607-627.

McLanahan S, Percheski C. Family structure and the reproduction of inequalities. *Annual Review of Sociology*. 2008;34:257–276.

Michael, R. T. (1972). *The effect of education on efficiency in consumption.* New York, NY: Columbia University Press.

Oaxaca, R. (1973) Male-female wage differentials in urban labor markets, *International Economic Review*, 14(3): 693-709.

Phillips, M. (2011). Parenting, time use, and disparities in academic outcomes. In G. Duncan & R. Murnane (Eds.). *Whither Opportunity? Rising Inequality, Schools, and Children's Life Chances* (pp. 207-228). New York: Russell Sage Foundation and Spencer Foundation.

Ramey, G., and Ramey, V. (2010). “The Rug Rat Race.” *Brookings Papers on Economic Activity*, 129–176.

Reardon, S. (2011). The Widening Academic Achievement Gap between the Rich and the Poor: New Evidence and Possible Explanations. In G. Duncan & R. Murnane (Eds.). *Whither*

Opportunity? Rising Inequality, Schools, and Children's Life Chances (pp. 91-116). New York: Russell Sage Foundation and Spencer Foundation.

Reardon, S. F., and K. Bischoff. (2011). Income Inequality and Income Segregation. *American Journal of Sociology* 116(4), 1092-1153.

White House Council on Women and Girls. (2011). Women in America: Indicators of Social and Economic Well-Being. Available at http://www.whitehouse.gov/sites/default/files/rss_viewer/Women_in_America.pdf

Table 1: Coefficients, standard errors and standardized coefficients from regressions of children's completed schooling on family income and demographic measures

	All cohorts	First half/ second half			First, middle and last six years		
	Age 14 in 1968-1999	Age 14 in 1968-1981	Age 14 in 1982-1999		Age 14 in 1968-1973	Age 14 in 1980-1985	Age 14 in 1994-1999
Parent income (average, age 14-16, in 2010$)							
Regression 1: Linear form	.069*** (.005) [β=.187]	.074*** (.008) [β= .185]	.064*** (.007) [β=.187]	*p* = .323	.071*** (.012) [β=.171]	.047*** (.013) [β=.127]	.059*** (.009) [β=.188]
Regression 2: Natural log form	.636*** (.043) [β= .218]	.696*** (.070) [β=.208]	.613*** (.056) [β=.233]	*p* = .360	.749*** (.108) [β=.214]	.602*** (.105) [β=.210]	.601*** (.081) [β=.236]
Other demographic measures (coefficients from regression #2)							
Single parent family (% of years, age 14-16	-.107 (.067) [β=-.021]	.064 (.107) [β=.011]	-.230** (.086) [β=-.049]	*p* < .05	.140 (.163) [β=.023]	.133 (.174) [β=.026]	-.559*** (.123) [β=-.123]
Number of siblings	-.138*** (.012) [β=-.145]	-.156*** (.015) [β=-.189]	-.046* (.023) [β=-.034]	*p* < .001	-.155*** (.021) [β=-.194]	-.095** (.035) [β=-.096]	-.044 (.041) [β=-.026]
Head's years of education	.201*** (.008) [β=.309]	.174*** (.011) [β=.292]	.231*** (.014) [β=.310]	p<.01	.153*** (.016) [β=.276]	.244*** (.024) [β=.338]	.213*** (.021) [β=.296]
Mother's age at birth	.060*** (.004)	.048*** (.006)	.066*** (.006)	p<.05	.052*** (.009)	.075*** (.012)	.074*** (.010)

	[β=.170]	[β=.141]	[β=.181]	[β=.151]	[β=.215]	[β=.195]
Other controls	incl.	incl.	incl.	incl.	incl.	incl.
Number of observations	6,076	3,009	3,067	1,341	954	1,312

Regressions are weighted using the PSID attrition-adjusted weight. Family-cluster-adjusted standard errors are given in parentheses. Standardized coefficients are given in brackets.

***p<.01; **p<.05; *p<.10

Table 2: Trends in income effect before and after adjusting for trends in other demographic measures

	Raw score coefficients		Standardized coefficients	
	No controls for other interactions (five separate regressions)	Incl. controls for other interactions	No controls for other interactions (five separate regressions)	Incl. controls for other interactions
ln income * CY turned 14	.008* (.003)	-.006 (.005)	.008*** (.003)	-.005 (.003)
Single parent * CY turned 14	-.027*** (.006)	-.030*** (.007)	-.012*** (.003)	-.013*** (.003)
# of sibs * CY turned 14	.003* (.001)	.004** (.001)	.007* (.003)	.010** (.004)
Head education* CY turned 14	.002** (.001)	.003*** (.001)	.007** (.002)	.009*** (.003)
Mother age at birth* CY turned 14	.001* (.000)	.000 (.000)	.006* (.002)	.004 (.002)

Note: All regressions include controls for main effects of all variables, race/ethnicity, sex, and firstborn status. Regressions are weighted using the PSID attrition-adjusted weight. Family-cluster-adjusted standard errors are given in parentheses.

***p<.01; **p<.05; *p<.10

Table 3: Accounting for increases in the schooling gap between the top and bottom income quintiles with mean changes in income and demographic measures

	Last minus first six years in period (total increase in schooling gap is .43 years)			Last minus middle six years in period (total increase in schooling gap is .55 years)		
	$2^{nd} – 1^{st}$ period change in gap	Amount of schooling gap accounted for	Percent of gap accounted for	$2^{nd} – 1^{st}$ period change in gap	Amount of schooling gap accounted for	Percent of gap accounted for
Completed schooling	0.43 years			0.55 years		
Parent income in $10K						
Linear	4.25	0.29	67.4%	2.60	0.17	30.9%
Natural log	0.50	0.32	74.0%	0.20	0.12	22.3%
Single parent family	-0.21	0.02	5.3%	-0.12	0.03	14.9%
Number of siblings	0.75	-0.10	-24.1%	0.02	0.00	-.20%
Head’s years of education	-1.09	-0.22	-51.0%	0.67	0.15	28.1%
Mother age at birth	4.45	0.27	62.1%	1.37	0.09	16.4%

Note: “Last minus first six years” gap changes are weighted by the “all cohorts” regression results shown in the first column of Table 2. “Last minus middle six years” gap changes are weighted by the “Age 14 in 1982-1999” regression results shown in the third column of Table 2.

Appendix Table 1: Correlation matrix of independent variables (weighted)

	All cohorts					
	Parent income (average, age 14-16, in natural log)	Child's completed schooling	Single parent family (% of years, age 14-16)	Number of siblings	Head's years of education	Mother's age at birth
Parent income (average, age 14-16, in natural log)	---					
Child's completed schooling	.398***	---				
Single parent family (% of years, age 14-16)	-.528***	-.161***	---			
Number of siblings	-.129***	-.239***	-.021	---		
Head's years of education	.464***	.461***	-.112***	-.301***	---	
Mother's age at birth	.166***	.153***	-.078***	.257***	.060***	---
	Last six years of period (1994-1999)					
	Parent income (average, age 14-16, in natural log)	Child's completed schooling	Single parent family (% of years, age 14-16)	Number of siblings	Head's years of education	Mother's age at birth
Parent income (average, age 14-16, in natural log)	---					
Child's completed schooling	.507***	---				
Single parent family (% of years, age 14-16)	-.558***	-.340***	---			
Number of siblings	-.227***	-.191***	.063*	---		
Head's years of education	.549***	.482***	-.195***	-.291***	---	
Mother's age at birth	.293***	.321***	-.175***	.025	.307***	---

Appendix Table 2: Means and standard deviations for variables used in the analysis, by year turned age 14

	All cohorts		First /second half of period				First /middle/last six years of period			
			Age 14 in 1968-1981	Age 14 in 1982-1999	p level of difference		Age 14 in 1968-1973	Age 14 in 1980-1985	Age 14 in 1994-1999	p level of difference
Years of completed schooling										
All	13.20 (2.03)		12.92 (2.03)	13.45 (1.99)	*p* < .001		12.79 (1.96)	13.07 (2.03)	13.70 (2.02)	*p* < .001
Bottom quintile	11.88 (1.65)		11.67 (1.64)	12.00 (1.65)	*p* < .001		11.44 (1.92)	11.74 (1.75)	12.21 (1.66)	*p* < .001
2nd quintile	12.41 (1.79)		11.83 (1.74)	12.74 (1.73)	*p* < .001		11.61 (1.69)	12.50 (2.02)	12.65 (1.66)	*p* < .001
3rd quintile	12.92 (1.84)		12.64 (1.81)	13.19 (1.84)	*p* < .001		12.55 (1.88)	12.80 (1.81)	13.43 (1.85)	*p* < .001
4th quintile	13.37 (1.88)		12.91 (1.78)	13.85 (1.86)	*p* < .001		12.65 (1.61)	13.40 (2.87)	14.25 (1.87)	*p* < .001
Top quintile	14.21 (1.99)		13.87 (2.09)	14.58 (1.81)	*p* < .001		13.76 (1.92)	13.94 (1.95)	14.96 (1.70)	*p* < .001
Top minus bottom quintile	2.33 (.08)		2.20 (.13)	2.58 (.11)	*p* < .05		2.32 (.20)	2.20 (.21)	2.75 (.13)	
Parent income (average, age 14-16, in 2010$)										
All	8.71 (5.45)		8.86 (5.03)	8.58 (5.78)	*p* < .05		8.65 (4.76)	8.24 (5.49)	9.05 (6.43)	*p* < .01
Bottom quintile	2.00 (.70)		2.23 (.58)	1.87 (.73)	*p* < .001		2.34 (.52)	1.97 (.68)	1.93 (.73)	*p* < .001
2nd quintile	4.11 (.69)		4.09 (.61)	4.12 (.74)	*p* = .491		3.95 (.54)	3.96 (.70)	3.97 (.66)	*p* = .973
3rd quintile	6.28 (.83)		6.11 (.79)	6.43 (.84)	*p* < .001		5.91 (.74)	5.89 (.74)	6.47 (.88)	*p* < .001
4th quintile	8.92 (1.19)		8.59 (1.14)	9.27 (1.15)	*p* < .001		8.19 (.99)	8.44 (1.07)	9.57 (1.20)	*p* < .001
Top quintile	15.32		14.48	16.22	*p* < .001		13.79	15.08	17.64	*p* < .001

	(4.77)		(4.42)	(4.96)			(4.45)	(5.11)	(5.17)	
Top minus bottom quintile	13.32 (.12)		12.25 (.18)	14.35 (.16)	$p < .001$		11.46 (.29)	13.11 (.31)	15.71 (.25)	
Parent income (average, age 14-16, in natural log)										
All	1.96 (.69)		2.02 (.61)	1.90 (.76)	$p < .001$		2.01 (.56)	1.89 (.71)	1.93 (.79)	$p < .001$
Bottom quintile	.62 (.41)		.76 (.30)	.54 (.44)	$p < .001$		.82 (.25)	.61 (.40)	.57 (.43)	$p < .001$
2^{nd} quintile	1.40 (.17)		1.40 (.15)	1.40 (.19)	$p = .894$		1.37 (.14)	1.36 (.18)	1.36 (.17)	$p = .948$
3^{rd} quintile	1.83 (.13)		1.80 (.13)	1.85 (.13)	$p < .001$		1.77 (.13)	1.77 (.12)	1.86 (.14)	$p < .001$
4^{th} quintile	2.18 (.13)		2.14 (.13)	2.22 (.12)	$p < .001$		2.10 (.12)	2.13 (.13)	2.25 (.13)	$p < .001$
Top quintile	2.69 (.28)		2.63 (.27)	2.74 (.28)	$p < .001$		2.58 (.27)	2.67 (.30)	2.83 (.28)	$p < .001$
Top minus bottom quintile	2.07 (.01)		1.87 (.01)	2.20 (.01)	$p < .001$		1.76 (.02)	2.06 (.03)	2.26 (.02)	
Single parent family (% of years, age 14-16)	22.35 (39.80)		15.91 (34.95)	28.00 (42.82)	$p < .001$		13.33 (32.46)	21.43 (38.95)	31.26 (44.34)	$p < .001$
Bottom quintile	68.59 (44.27)		59.08 (47.77)	74.06 (41.17)	$p < .001$		50.80 (48.27)	60.04 (47.66)	74.64 (40.57)	$p < .001$
2^{nd} quintile	44.09 (47.16)		38.06 (46.69)	47.55 (47.11)	$p = .157$		32.62 (45.95)	40.91 (46.35)	52.86 (47.28)	$p < .05$
3^{rd} quintile	21.23 (39.06)		16.29 (35.51)	25.84 (41.62)	$p < .01$		14.01 (33.05)	23.97 (41.27)	33.96 (44.83)	$p < .01$
4^{th} quintile	8.85 (25.47)		6.56 (21.45)	11.24 (28.91)	$p = .084$		6.56 (21.92)	6.19 (19.43)	13.26 (31.38)	$p < .05$
Top quintile	4.11 (17.64)		2.69 (14.12)	5.62 (20.66)	$p < .05$		3.54 (17.00)	3.03 (13.54)	5.93 (22.20)	$p = .240$
Top minus bottom	-64.49		-56.39	-68.44	$p < .001$		-47.26	-57.01	-68.71	

quintile	(1.50)		(2.08)	(2.15)			(3.23)	(3.68)	(3.31)	
Number of siblings	2.73 (2.12)		3.51 (2.46)	2.04 (1.46)	$p < .001$		3.76 (2.45)	2.55 (2.05)	1.92 (1.19)	$p < .001$
Bottom quintile	3.21 (2.45)		4.50 (3.05)	2.47 (1.61)	$p < .001$		4.85 (2.79)	3.22 (2.44)	2.42 (1.39)	$p < .001$
2nd quintile	3.05 (2.47)		4.46 (2.91)	2.24 (1.72)	$p < .001$		5.12 (3.00)	2.74 (2.35)	2.18 (1.28)	$p < .001$
3rd quintile	2.74 (2.16)		3.50 (2.48)	2.03 (1.51)	$p < .001$		3.86 (2.57)	2.62 (2.05)	1.78 (1.15)	$p < .001$
4th quintile	2.50 (1.67)		3.09 (1.84)	1.89 (1.21)	$p < .001$		3.34 (1.90)	2.12 (1.38)	1.81 (1.20)	$p < .001$
Top quintile	2.53 (1.03)		3.22 (2.34)	1.80 (1.27)	$p < .001$		3.34 (2.27)	2.42 (2.02)	1.65 (.87)	$p < .001$
Top minus bottom quintile	-.68 (.09)		-1.28 (.17)	-.68 (.07)	$p < .001$		-1.52 (.26)	-.79 (.22)	-.77 (.10)	
Head's years of education	12.34 (3.10)		11.65 (3.39)	12.95 (2.68)	$p < .001$		11.28 (3.53)	12.40 (2.81)	13.09 (2.82)	$p < .001$
Bottom quintile	10.02 (2.93)		8.86 (3.19)	10.69 (2.53)	$p < .001$		7.86 (3.55)	10.37 (2.53)	10.72 (2.84)	$p < .001$
2nd quintile	11.03 (3.05)		9.57 (3.37)	11.86 (2.49)	$p < .001$		9.11 (3.51)	11.22 (3.05)	11.63 (2.55)	$p < .001$
3rd quintile	11.63 (2.89)		10.58 (3.00)	12.61 (2.39)	$p < .001$		9.97 (3.10)	11.80 (2.39)	12.74 (2.38)	$p < .001$
4th quintile	12.67 (2.75)		11.98 (2.99)	13.40 (2.25)	$p < .001$		11.61 (3.00)	12.83 (2.52)	13.66 (2.27)	$p < .001$
Top quintile	14.17 (2.43)		13.62 (2.66)	14.77 (2.01)	$p < .001$		13.35 (2.77)	14.10 (2.15)	15.12 (1.93)	$p < .001$
Top minus bottom quintile	4.15 (.12)		4.76 (.20)	4.07 (.14)	$p < .05$		5.49 (.34)	3.73 (.27)	4.40 (.21)	
Mother's age at birth	25.89 (5.69)		26.42 (5.91)	25.42 (5.46)	$p < .001$		26.45 (5.66)	24.96 (5.89)	26.12 (5.31)	$p < .001$
Bottom quintile	24.84		26.80	23.72	$p < .001$		27.89	23.56	24.73	$p < .001$

	(7.02)		(7.33)	(6.59)			(7.02)	(6.79)	(6.48)	
2nd quintile	24.82 (5.81)		25.79 (6.36)	24.26 (5.40)	$p < .001$		25.92 (6.49)	24.85 (6.40)	23.67 (4.78)	$p < .001$
3rd quintile	25.41 (5.72)		25.92 (6.07)	24.93 (5.34)	$p < .01$		25.65 (5.82)	24.57 (5.41)	24.86 (5.37)	$p = .093$
4th quintile	25.71 (5.14)		25.86 (5.40)	25.56 (4.86)	$p = .308$		25.76 (5.33)	24.66 (5.53)	26.96 (4.64)	$p < .001$
Top quintile	27.35 (5.13)		27.33 (5.44)	27.36 (4.78)	$p = .913$		27.39 (4.97)	26.15 (5.57)	28.68 (4.05)	$p < .001$
Top minus bottom quintile	2.51 (.26)		.53 (.41)	3.65 (.33)	$p < .01$		-.50 (.60)	2.58 (.66)	3.95 (.46)	
Child first born?	33.40 (---)		26.30 (---)	39.62 (---)	$p < .001$		25.41 (---)	35.05 (---)	38.60 (---)	$p < .001$
Child male?	49.43 (---)		49.36 (---)	49.49 (---)	$p = .686$		49.24 (---)	50.42 (---)	47.40 (---)	$p = .329$
Black?	13.89 (---)		11.66 (---)	15.85 (---)	$p = .038$		10.49 (---)	13.40 (---)	18.37 (---)	$p < .001$
Hispanic?	3.41 (---)		3.61 (---)	3.23 (---)	$p = .008$		2.74 (---)	2.95 (---)	4.46 (---)	$p = .033$
Number of observations	6,141		3,017	3.124			1,342	955	1.356	

Note: Income quintiles are defined by family income averaged over ages 14-16 for each birth cohort.

Appendix Table 3: Coefficients and standard errors from regressions of children's completed schooling on family income and demographic measures

	All cohorts	First /second half of period			First/last six years in period			Middle/last six years in period		
		Age 14 in 1968-1981	Age 14 in 1982-1999	Difference	Age 14 in 1968-1973	Age 14 in 1994-1999	Difference	Age 14 in 1980-1985	Age 14 in 1994-1999	Difference
Parent income (average, age 14-16, in 2010$)										
Regression 1: Quintile form										
Lowest	(ref)	(ref)	(ref)		(ref)	(ref)		(ref)	(ref)	
Second	.321*** (.087)	.126 (.141)	.403*** (.110)	*p* =.122	.188 (.220)	.173 (.159)	*p* = .958	.548** (.212)	.173 (.159)	*p* = .150
Third	.651*** (.090)	.668*** (.138)	.623*** (.119)	*p* =.808	.918*** (.209)	.564** (.170)	*p* = .190	.862*** (.216)	.564** (.170)	*p* = .271
Fourth	.807*** (.093)	.638*** (.142)	1.015*** (.125)	*p* < .05	.701** (.213)	.984*** (.181)	*p* = .313	1.166*** (.228)	.984*** (.181)	*p* = .526
Highest	1.274*** (.097)	1.298*** (.148)	1.299*** (.132)	*p* =.995	1.507*** (.223)	1.207*** (.194)	*p* = .309	1.381*** (.236)	1.207*** (.194)	*p* = .564
Regression 2: Linear form	.069*** (.005)	.074*** (.008)	.064*** (.007)	*p* = .323	.071*** (.012)	.059*** (.009)	*p* = .450	.047*** (.013)	.059*** (.009)	*p* = .420
Regression 3: Natural log form	.636*** (.043)	.696*** (.070)	.613*** (.056)	*p* = .360	.749*** (.108)	.601*** (.081)	*p* = .275	.602*** (.105)	.601*** (.081)	*p* = .996
Other demographic measures (coefficients from regression #1)										
Single parent family (% of years, age 14-16	-.148* (.068)	.036 (.108)	-.250** (.086)	*p* < .05	.140 (.122)	-.575*** (.124)	*p* < .001	.201 (.177)	-.575*** (.124)	*p* < .001
Number of siblings	-.141*** (.012)	-.157*** (.015)	-.048* (.023)	*p* < .001	-.152*** (.021)	-.045 (.041)	*p* < .05	-.092** (.035)	-.045 (.041)	*p* = .379
Head's years of education	.204*** (.008)	.173*** (.011)	.234*** (.014)	*p* < .001	.151*** (.016)	.218*** (.021)	*p* < .01	.245*** (.024)	.218*** (.021)	*p* = .373
Mother's age at birth	.062*** (.004)	.047*** (.006)	.068*** (.006)	*p* < .05	.050*** (.009)	.071*** (.010)	*p* = .126	.076*** (.012)	.071*** (.010)	*p* = .752
Child first born?	.332***	.234**	.417***	*p* = .096	.184	.601***	*p* < .01	.480**	.601***	*p* = .483

	(.054)	(.084)	(.070)		(.122)	(.104)		(.140)	(.104)	
Child male?	-.263*** (.044)	-.120 (.063)	-.412*** (.060)	*p* < .01	-.201* (.092)	-.594*** (.088)	*p* < .01	-.239* (.113)	-.594*** (.088)	*p* < .05
Black?	.263*** (.070)	.432*** (.111)	.118 (.090)	*p* < .05	.412* (.170)	-.107 (.126)	*p* < .05	.588** (.190)	-.107 (.126)	*p* < .01
Hispanic?	.229 (.125)	-.149 (.175)	.565** (.177)	*p* < .01	-.142 (.292)	.990*** (.241)	*p* < .01	-.158 (.334)	.990*** (.241)	*p* < .01
R^2 (from regression #1)	.29	.27	.32		.27	.39		.28	.39	
Number of observations	6,076	3,009	3,067		1,341	1,312		954	1,312	

Regressions are weighted using the PSID attrition-adjusted weight. Regressions are weighted using the PSID attrition-adjusted weight. Family-cluster-adjusted standard errors are given in parentheses.

***p<.01; **p<.05; *p<.10

Appendix Table 4: Coefficients, standard errors and standardized coefficients from bivariate regressions of children's completed schooling on family income and demographic measures

	All cohorts	First half/ second half	
	Age 14 in 1968-1999	Age 14 in 1968-1981	Age 14 in 1982-1999
Parent income (average, age 14-16, in 2010$)			
Linear form	.146***	.144***	.149***
	(.004)	(.007)	(.006)
	[β=.393]	[β= .360]	[β=.432]
Natural log	1.164***	1.240***	1.183***
	(.034)	(.057)	(.042)
	[β= .398]	[β=.371]	[β=.449]
Other demographic measures			
Single parent family (% of years, age 14-16	-.820***	-.643***	-1.120**
	(.064)	(.105)	(.082)
	[β=-.161]	[β=-.111]	[β=-.241]
Number of siblings	-.228***	-.224***	-.174***
	(.012)	(.014)	(.024)
	[β=-.239]	[β=-.271]	[β=-.128]
Head's years of education	.301***	.256***	.352***
	(.007)	(.010)	(.012)
	[β=.461]	[β=.428]	[β=.474]
Mother's age at birth	.054***	.027***	.092***
	(.005)	(.006)	(.006)
	[β=.152]	[β=.078]	[β=.251]
Number of observations	6,076	3,009	3,067

Each coefficient comes from a bivariate regression of children's completed schooling on the given measure. Regressions are weighted using the PSID attrition-adjusted weight. Regressions are weighted using the PSID attrition-adjusted weight. Family-cluster-adjusted standard errors are given in parentheses.

***p<.01; **p<.05; *p<.10

Appendix Table 5: Coefficients and standard errors from weighted regressions of children's completed schooling on adolescent and full-childhood income and family structure for children born 1968-1985

	Dependent variable: children's completed schooling (OLS)					Logistic regressions (marginal effects)		
	Age 14-16 measures, no controls	Age 14-16 measures, with controls	Age 0-16, no controls	Age 0-16, controls	Stages, with controls	High school or more (no GED)	High school or more (includes GED)	College graduate
ln income	.947***	.470***	.991***	.572***	---	---	---	---
	(.034)	(.045)	(.033)	(.048)	---	---	---	---
Single parent		-.090*		-.032	---	---	---	---
		(.038)		(.043)	---	---	---	---
Head education		.616***		.590***	.641***	.066***	.052**	.109***
		(.036)		(.037)	(.040)	(.010)	(.008)	(.012)
# of sibs		-.108**		-.070	-.071	-.010	-.010	-.013
		(.036)		(.037)	(.038)	(.008)	(.007)	(.013)
Age of mother		.274***		.287***	.285***	.027**	.024**	.058***
		(.032)		(.036)	(.037)	(.010)	(.008)	(.011)
ln income, 0-5					.158*	.037*	.028*	.019
					(.064)	(.015)	(.011)	(.019)
ln income, 6-10					.014	.011	-.008	.007
					(.082)	(.018)	(.014)	(.026)
ln income 11-16					.411***	.035*	.027*	.083***
					(.070)	(.016)	(.012)	(.023)
Single parent, 0-5					-.079	-.001	.001	-.020
					(.062)	(.013)	(.011)	(.021)
Single parent, 6-10					.104	.014	-.007	.016

					(.068)	(.015)	(.012)	(.020)
Single parent, 11-16					-.119*	-.032*	-.007	-.021
					(.053)	(.012)	(.010)	(.016)
Other controls?	No	Yes	No	Yes	Yes	Yes	Yes	Yes
R^2	0.20	0.30	0.22	0.32	0.33	0.23	0.21	0.23
N	3,070	3,067	3,070	3,067	2,932	2,734	2,932	2,932

Logistic regression outcomes present marginal effects (dy/dx) and standard errors. All regressions are weighted using the PSID attrition-adjusted weight. Family-cluster-adjusted standard errors are given in parentheses.

***p<.01; **p<.05; *p<.10

Appendix Table 6: Gender differences in the associations and accounting shares between children's completed schooling and family demographic measures

	Coefficients and standard errors from regressions of children's completed schooling on family income and demographic measures – all cohorts			Accounting for schooling gap - Last minus first six years in period			
				Males only		Females only	
Independent variable (standardized)	Males	Females	p level of difference	2nd – 1st period change in gap	Percent of gap accounted for	2nd – 1st period change in gap	Percent of gap accounted for
ln Parent income	.42*** (.05)	.52*** (.04)	p<.10				
Single parent family	-.13*** (.04)	.02 (.04)	p<.05				
Number of siblings	-.29*** (.04)	-.41*** (.04)	p<.10				
Head's years of education	.72*** (.04)	.63*** (.04)	p<.10				
Mother age at birth	.35*** (.04)	.36*** (.04)	ns				
R^2	.30	.29					
Number of observations	2902	3174		2902	3174	2902	3174
Completed schooling				0.4x years		.4x years	

Note: Regressions are weighted using the PSID attrition-adjusted weight. Family-cluster-adjusted standard errors are given in parentheses. ***p<.01; **p<.05; *p<.10

Gap changes are weighted by gender-specific regression results shown in the first two columns.

ENDNOTES

[1] These data are reported in Duncan and Murnane (2011) and are from the U.S. Census Bureau, which started tracking annual family income in 1947.

[2] Bianchi et al. (2003), however, using different time use data, show that the rise in childcare time that started in about 1985 did not apply differentially to mothers (or fathers) with and without college degrees. Indeed, these authors conclude that from 1965-2000 there was no evidence that parental time investments were becoming more differentiated by educational attainment.

[3] Sean Reardon kindly supplied us with the CPS data.

[4] Apart from marriage between immigrants and nonimmigrants (and the 1997 addition of an immigrant cohort), the PSID has no mechanism for adding immigrants to its sample. Since both the NLSY79 and the NLS97 drew fresh dwelling-based samples of youth, their samples should include immigrants in the population at the time the samples were drawn. Given the generally lower college-graduation rates for immigrants, this ought to lead the NLS-based samples to show less of an increase in graduation rates than the PSID. On the other hand, the intergenerational trust built up by the PSID with its repeated contacts since 1968 might lead to higher response rates among highly disadvantaged youth, which would lead the PSID to show less of an increase in college graduation rates. Another possible source of difference is the age at which completed schooling is measured – 25 in the NLS and 24 in the PSID. Given the considerable schooling undertaken by low-income women in their 20s, the younger age may reduce completed schooling in the PSID relative to the NLS.

[5] It is tricky to think about timing issues. For one thing, our age 14-16 accounting period over which family income is measured was chosen for practical rather than conceptual reasons; it enabled us to gain as many PSID birth cohorts as possible for which both family income and children's completed schooling were measured at sensible ages. If income before or after the age 14-16 window matters the most for children's schooling, then our age 14-16 window may be providing an erroneous reading of the degree to which income inequality that may be causing disparities in completed schooling. We explore whole-childhood results later in the paper.

[6] We also estimated a piecewise linear relationships between income (and log income) and children's completed schooling fit to the first and second half of the period, which allows for separate linear segments for each income quintile. There was some indication (p values between .05 and .10) of an increase in the importance of the lowest income quintile, but nothing close to a statistically significant change elsewhere in the income distribution.

Figure 1: Top minus Bottom Income Quintile Differences in Children's Years of Completed Schooling

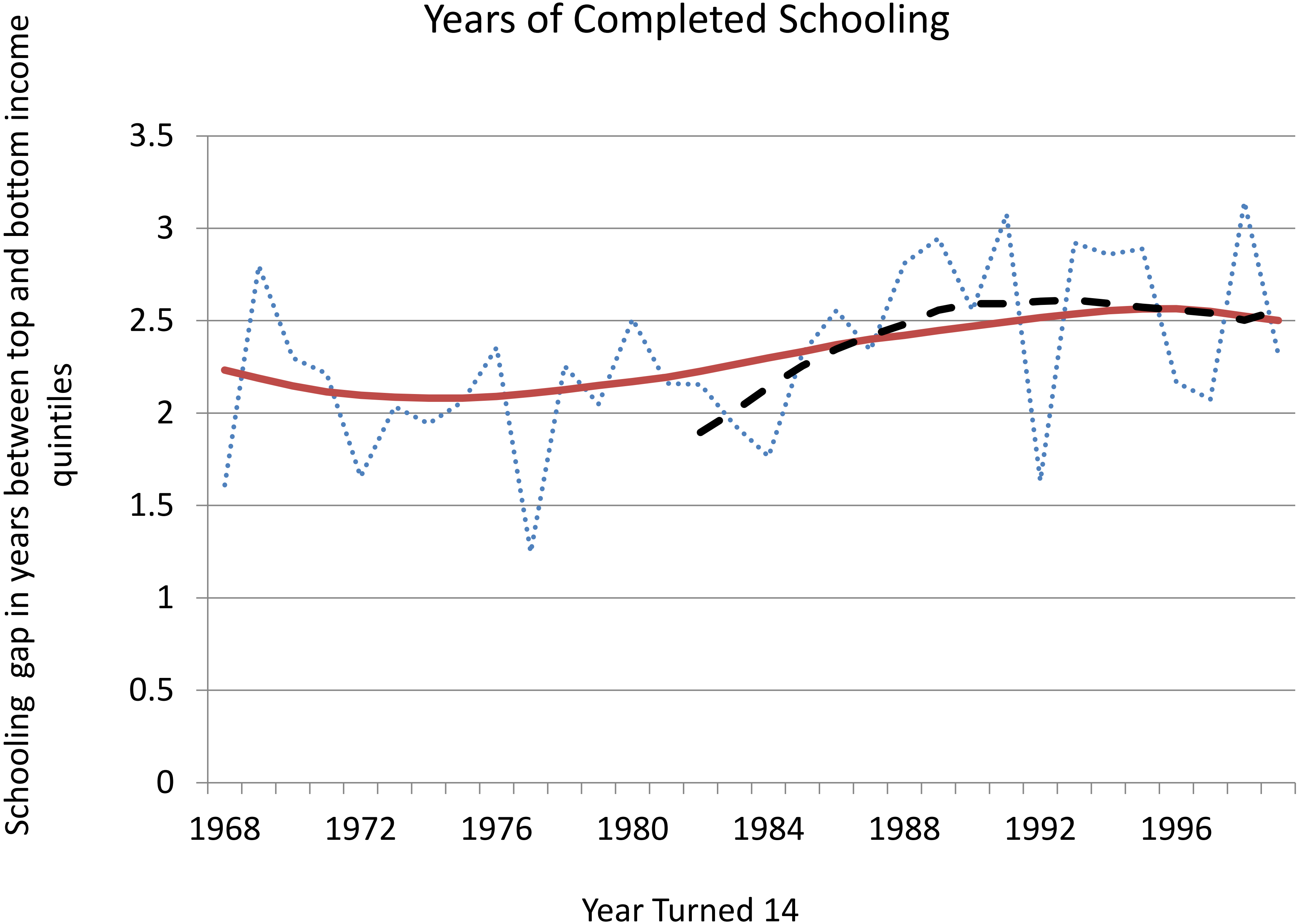
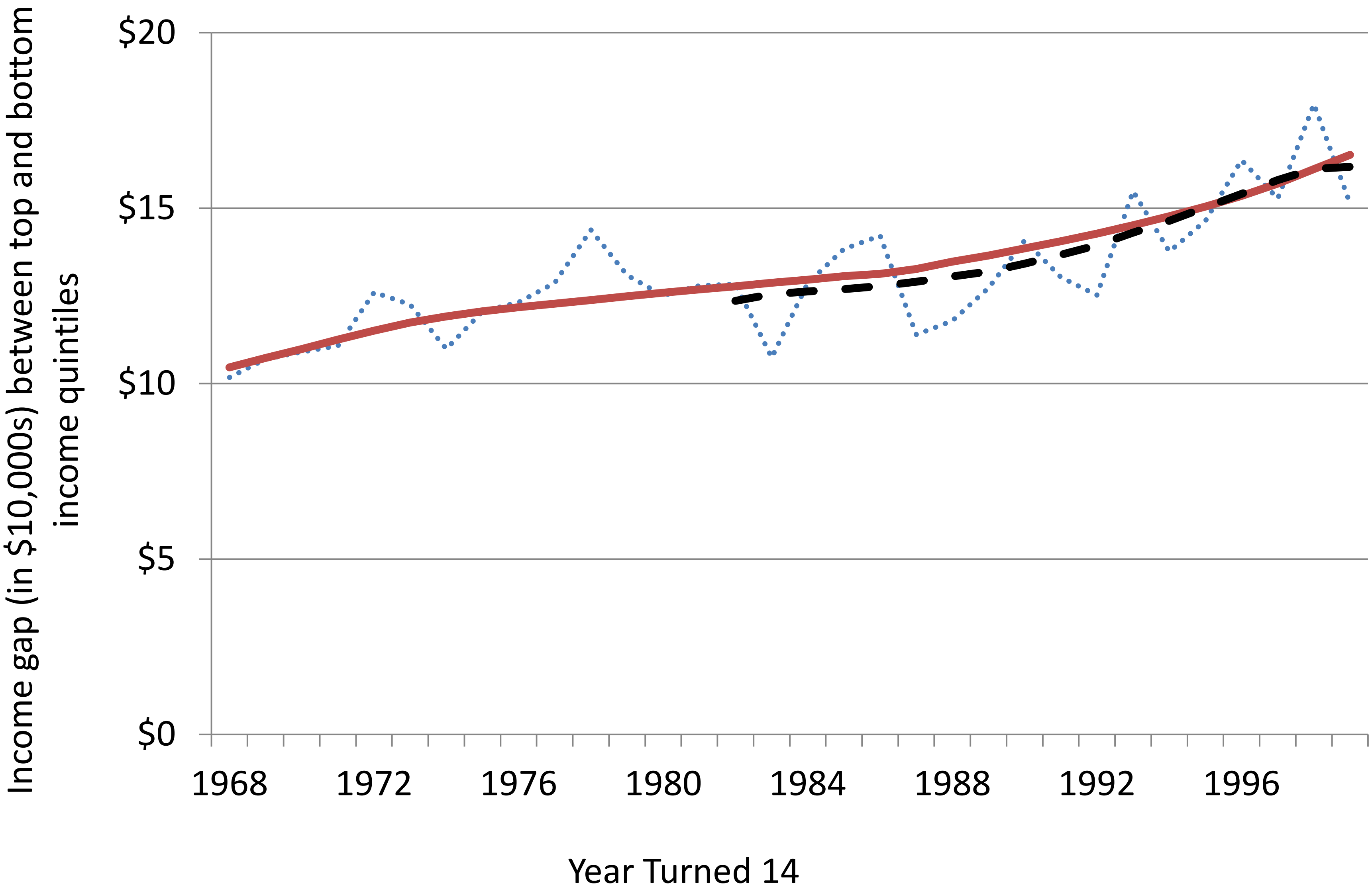


Figure 2: Top minus Bottom Income Quintile Differences in Cohort-Specific Family Income



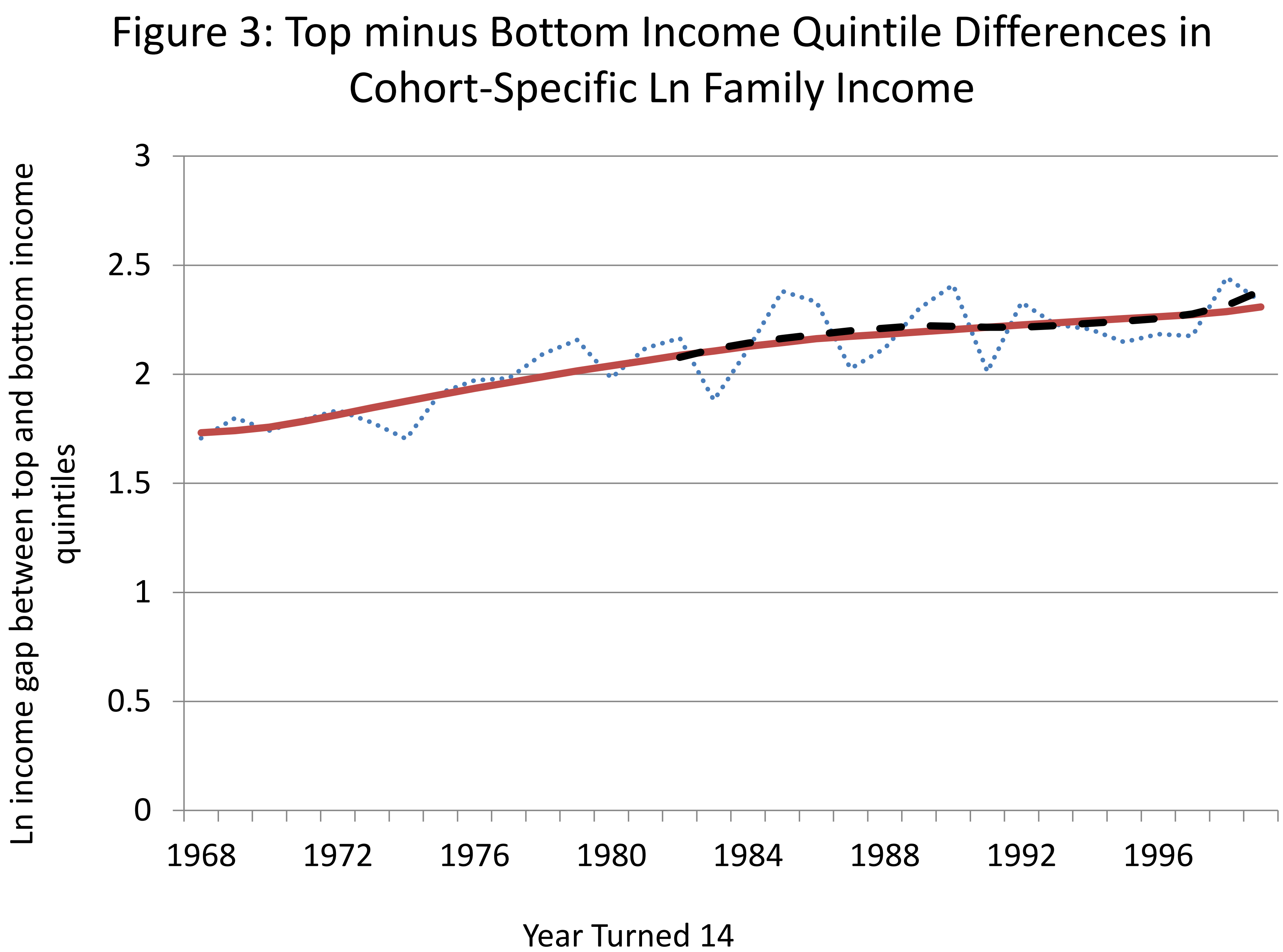


Figure 3: Top minus Bottom Income Quintile Differences in Cohort-Specific Ln Family Income
Ln income gap between top and bottom income quintiles
3
2.5
2
1.5
1
0.5
0
1968
1972
1976
1980
1984
1988
1992
1996
Year Turned 14

Figure 4: Top minus Bottom Income Quintile Differences in Single Parent Family Structure

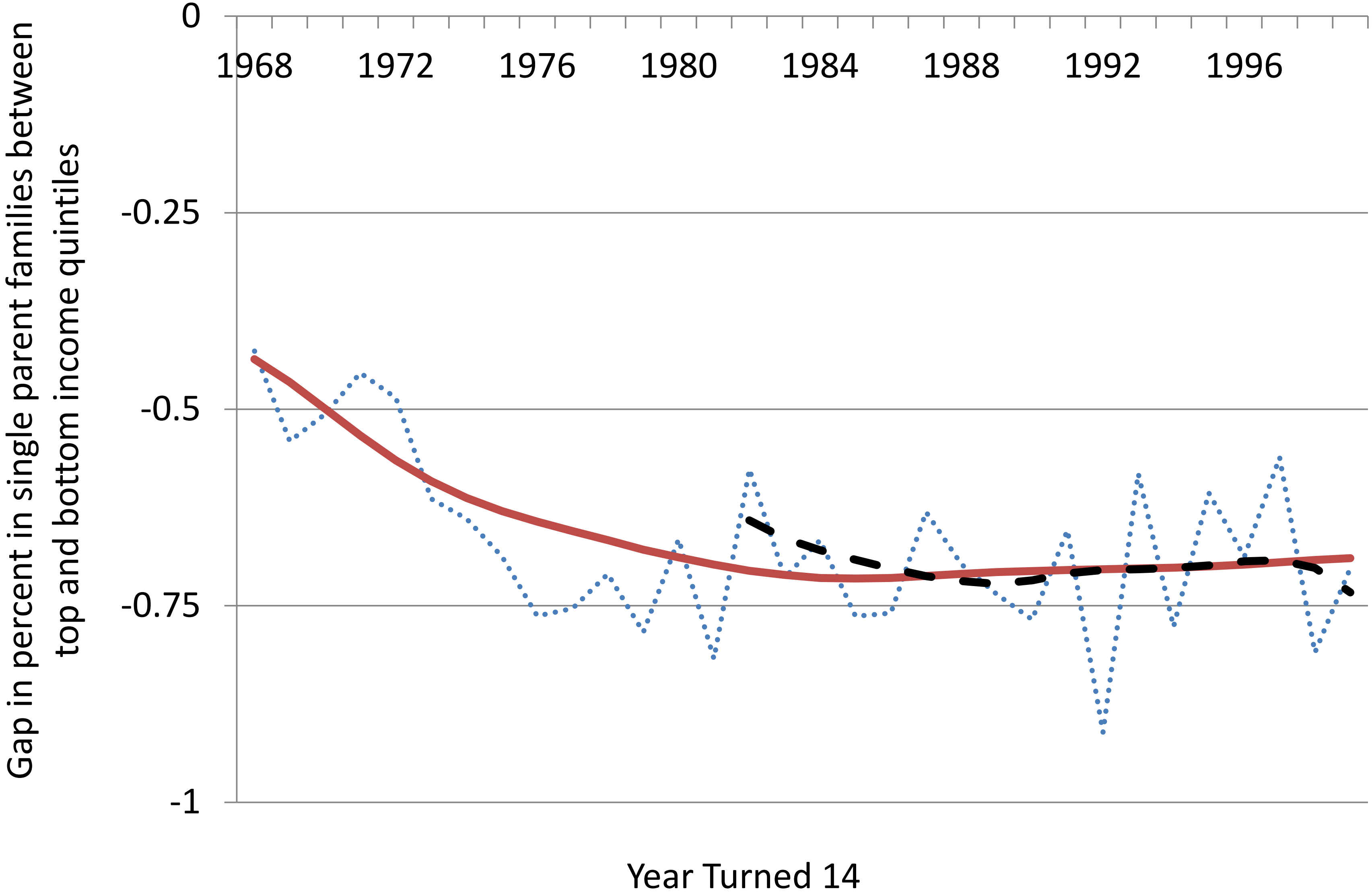


Figure 5: Top minus Bottom Income Quintile Differences in Age of Mother at Birth

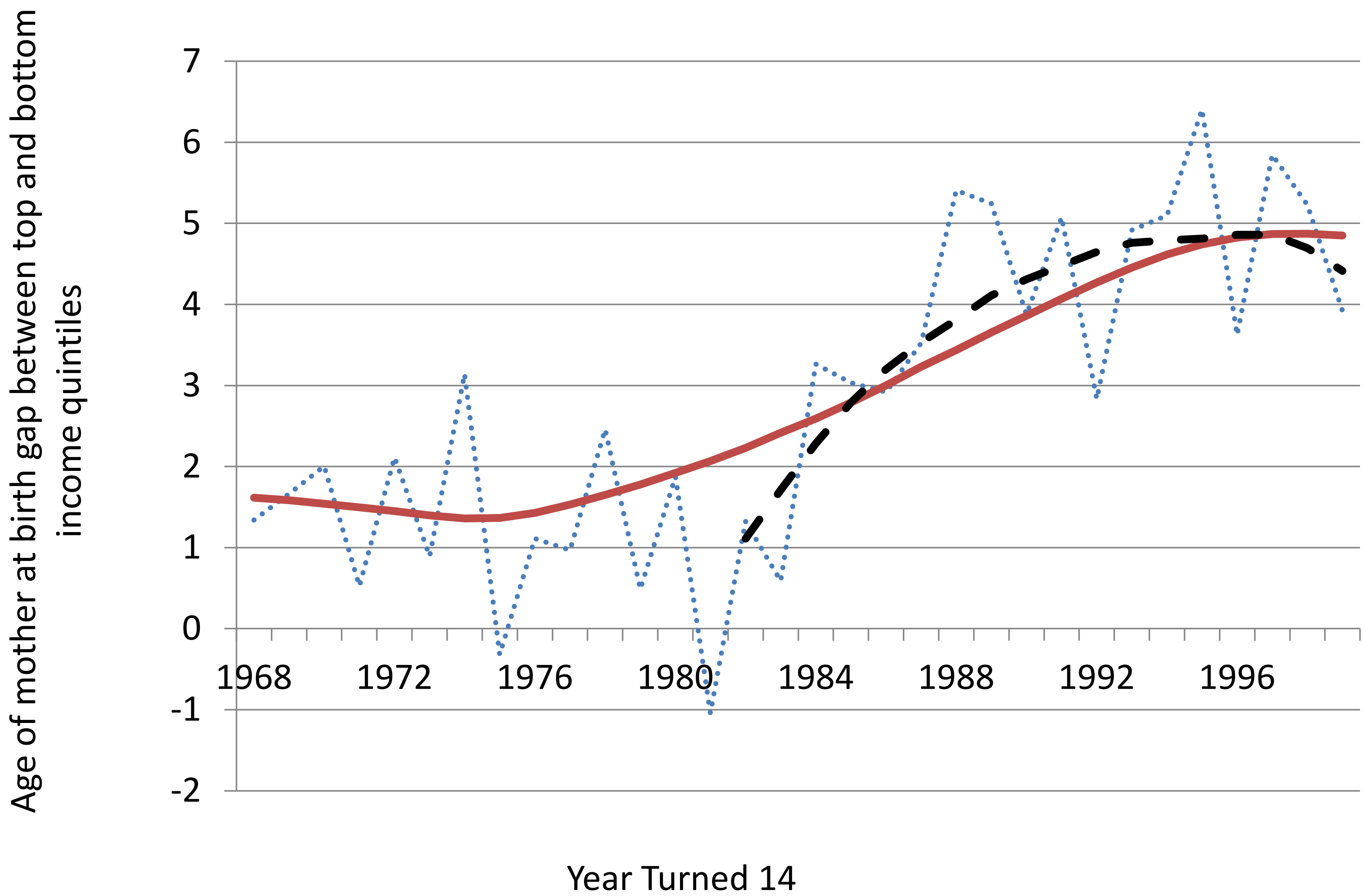


Figure 6: Top minus Bottom Income Quintile Differences in Parent Schooling

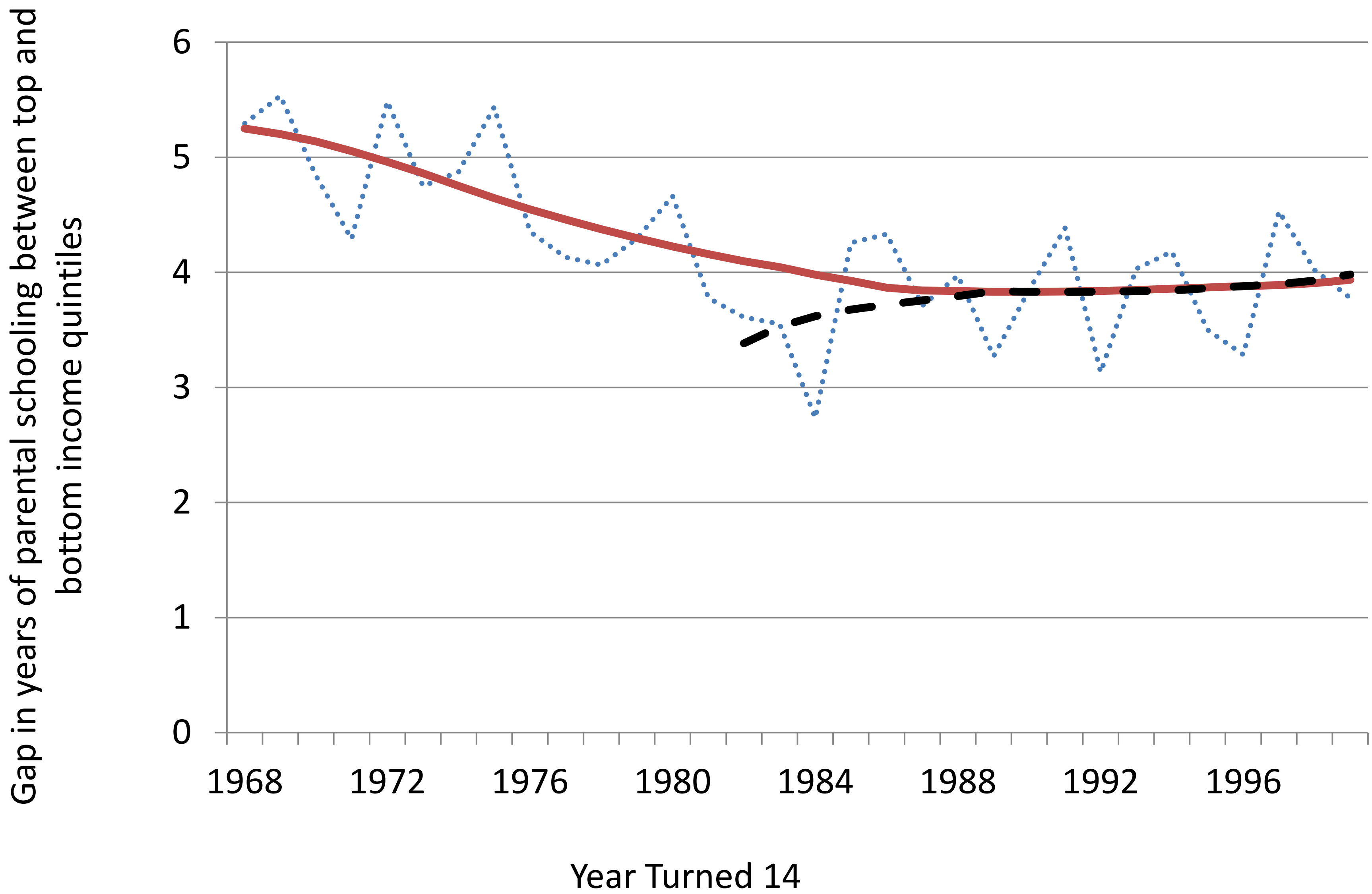


Figure 7: Top minus Bottom Income Quintile Differences in Number of Siblings

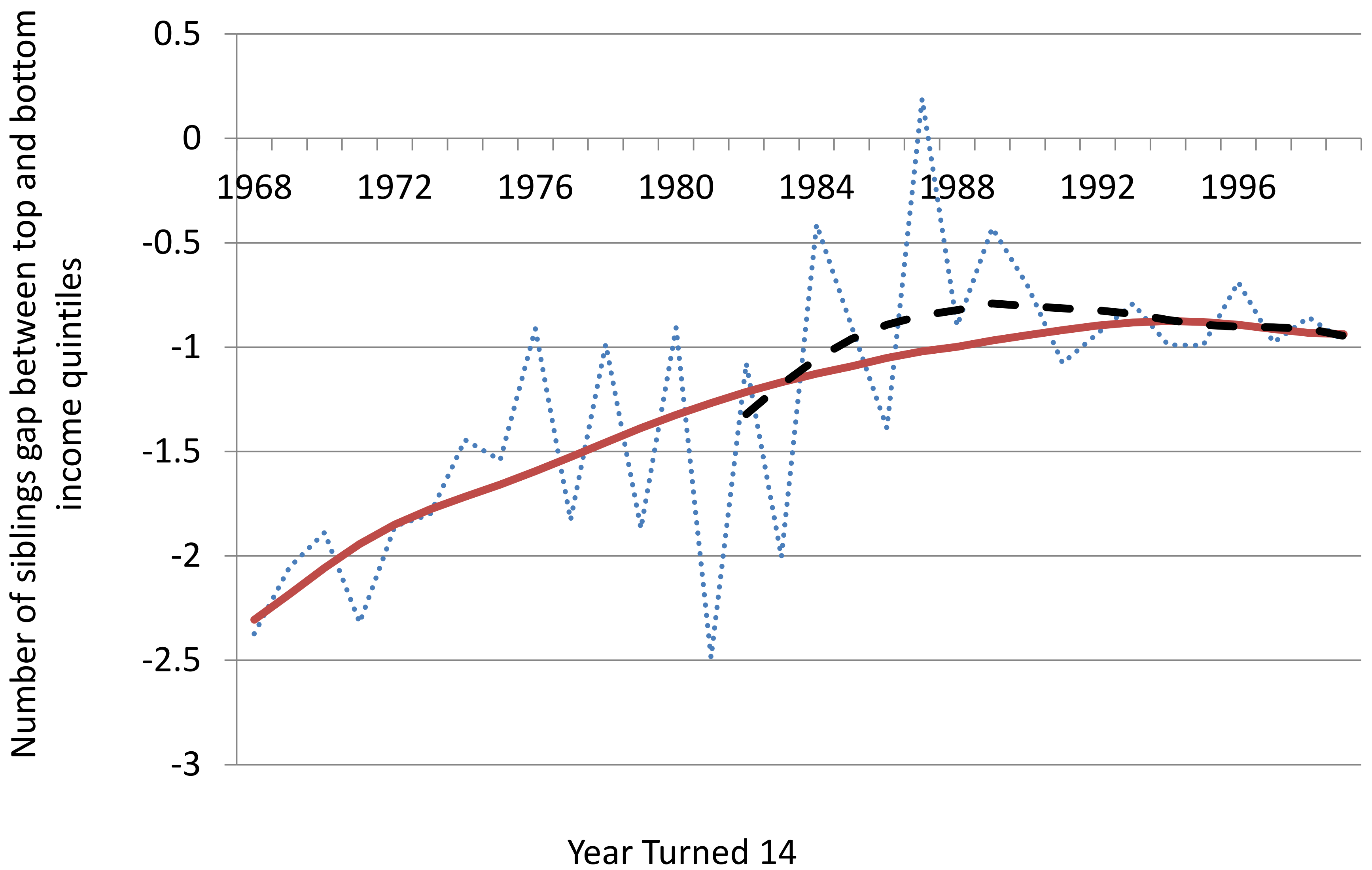


Figure 8: Linear Trends In Effects Of Demographic Measures But Not Family Income (All Standardized) On Children's Years Of Completed Schooling

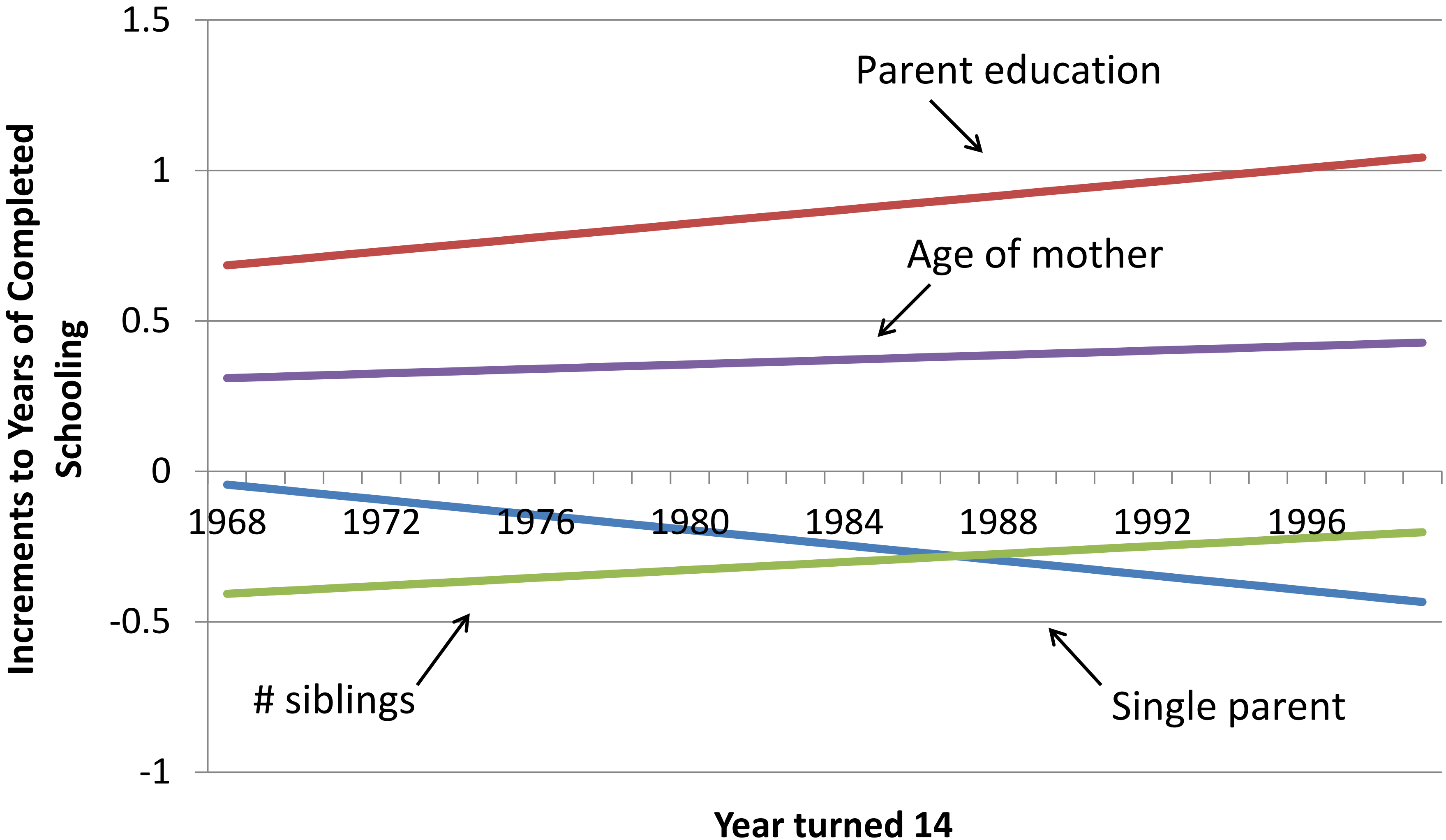


Figure 9: Linear Trends In Effects Of Demographic Measures Plus Family Income (All Standardized) On Children's Years Of Completed Schooling

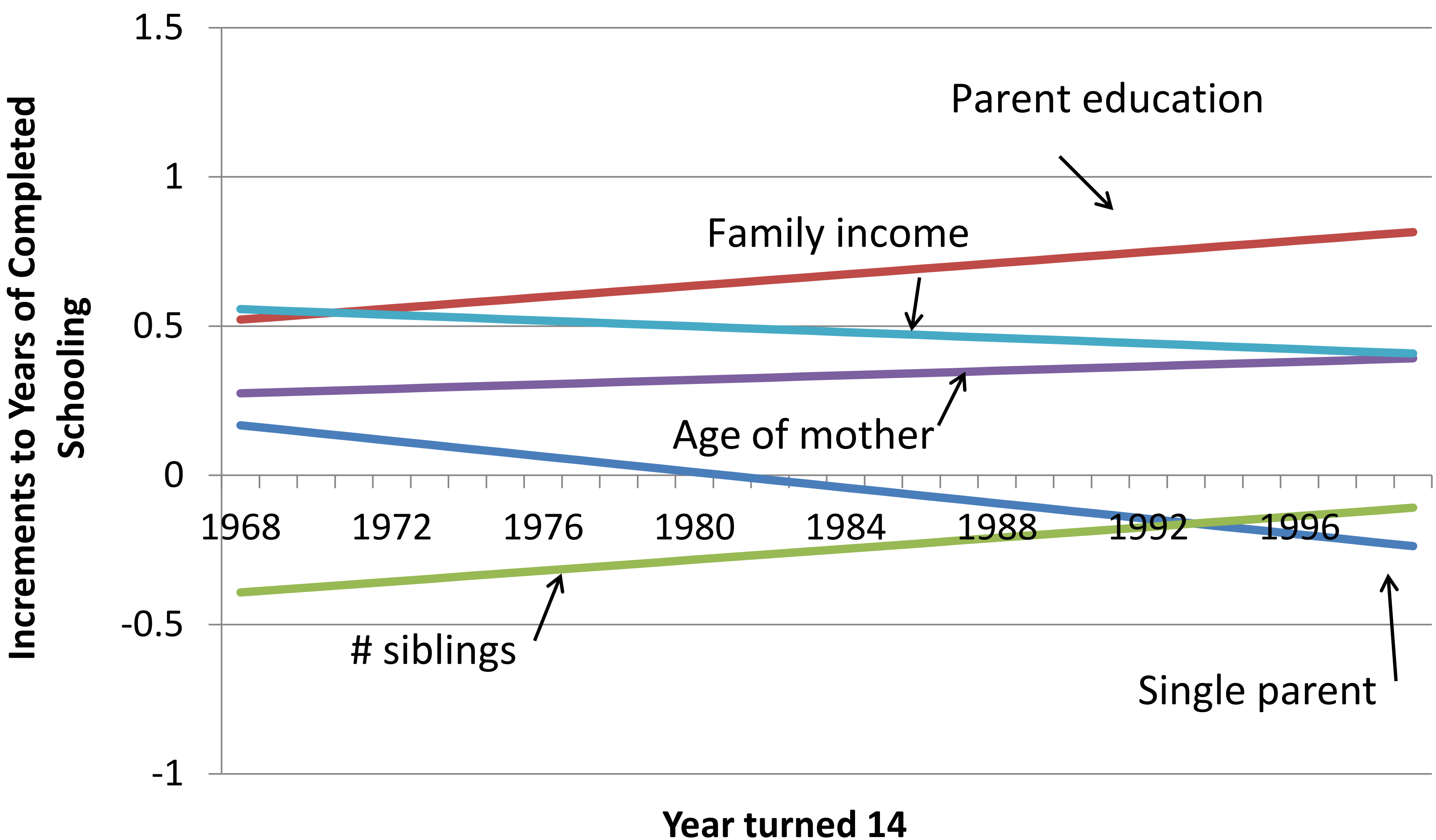
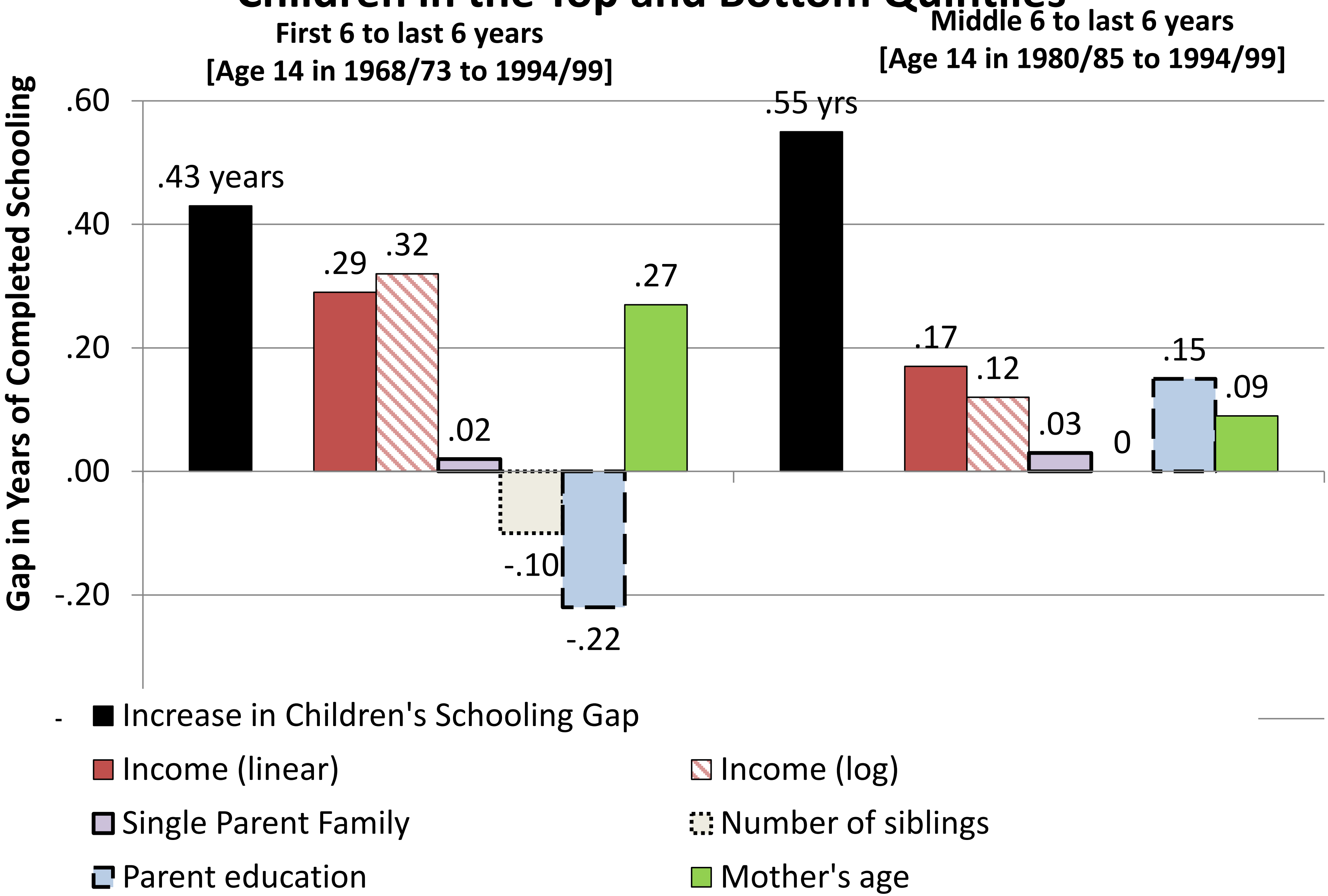
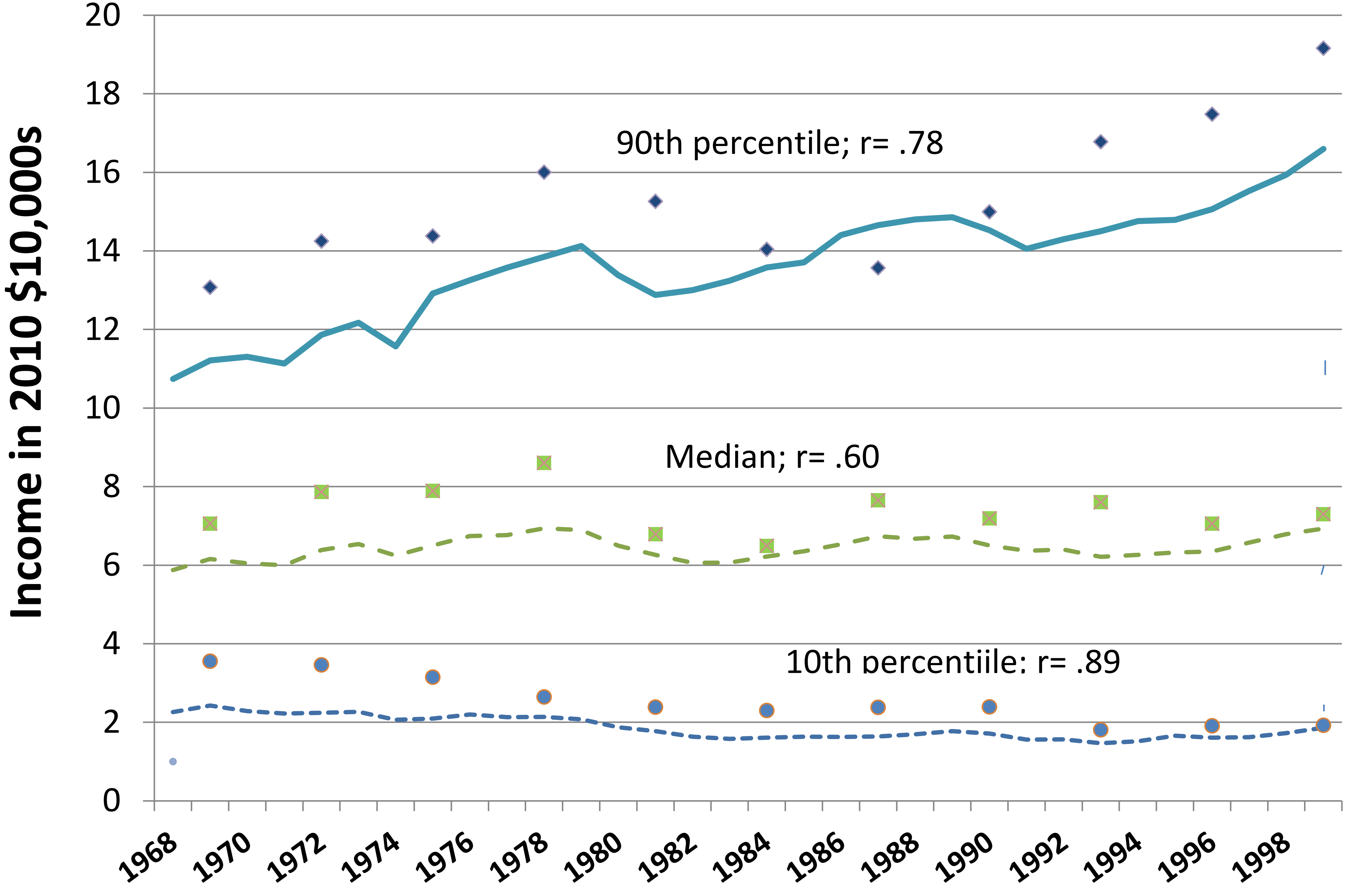


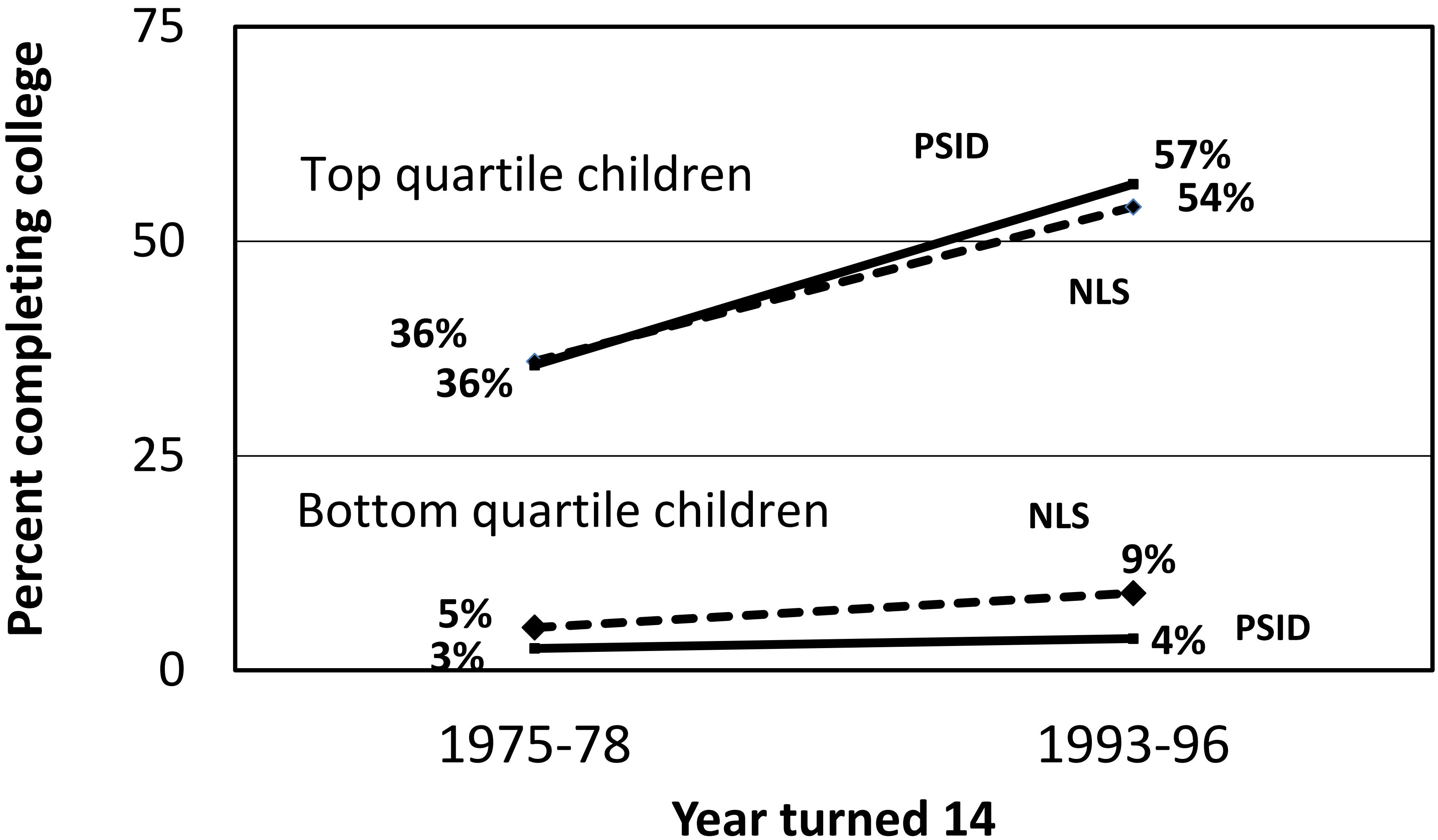
Figure 10: Accounting for Increases in the Schooling Gap for Children in the Top and Bottom Quintiles



Appendix Figure 1: CPS (all ages) and PSID (age 14) income distributions for children



Appendix Figure 2: College graduation rates for high and low income children in NLS and PSID



Bailey and Dynarski (2011) for NLSY; authors' calculations for the PSID