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What Does Increased Economic Inequality Imply about the Future Level and Dispersion of Human Capital?

Abstract

Does the persistent increase in economic inequality among families and geographic areas have implications for the levels of educational attainment of children who have experienced this development? In this study, we consider this question using longitudinal data on about 1,200 children from the Panel Study of Income Dynamics. We observe these children over a period of at least 20 years, and statistically estimate the relationship of the family, regional, and neighborhood factors that exist while they are growing up to the educational choices that they make as young adults. We examine three educational attainments of these children: (1) completed years of schooling, (2) graduation from high school, and (3) college attendance. The four economic variables that we use to reflect observed changes in economic inequality are (1) family income (relative to needs), (2) family net worth (wealth), (3) a state measure of inequality (the Gini coefficient), and (4) a measure of the accessibility of higher education (the cost of tuition at state colleges).

We use the coefficient estimates from our stylized model of children's educational attainments together with adjusted values of the economic variables reflecting increased inequality to simulate the effects of increased economic inequality on youths' schooling attainments. We measure the effects of increased economic inequality on the full distribution of educational attainments, and calculate changes in both the *average level* and the *dispersion* of educational attainment of the next generation of youths. We find that increased family and geographic economic inequality have small positive effects on the average level of schooling of this generation, but also significantly increase the inequality of their schooling attainments.

What Does Increased Economic Inequality Imply about the Future Level and Dispersion of Human Capital?

The past three decades have witnessed substantial growth in economic inequality among families and the neighborhoods in which they live. For example, between 1973 and 1998, the Gini coefficient of family income (reflecting both labor earnings and public transfers) rose 21 percent (see Haveman et al., 2004). Over the same period, inequality in both male and female labor earnings increased by nearly 30 percent. The urban neighborhoods in which many poor and minority children live have declined (Jargowsky, 1997), and since 1970 both affluent and poor families have become more concentrated in high-income and poor neighborhoods (Massey, 1996). Though of substantial concern, the implication of these trends in inequality for the development and attainment of both rich and poor children is both unknown and little studied (Jencks and Mayer, 1990).

In this paper, we study the relationship between these increases in family and geographic economic inequality and the educational attainments of young people—their years of completed schooling, the probability that they will graduate from high school, and the probability they will undertake postsecondary schooling. We relate observed changes in family and geographic economic inequality to both the average level and the inequality of their schooling attainments. We measure the changes in family and geographic economic inequality during the years when they were growing up (ages 2–15), and their schooling attainments when they are young adults (age 25).

Our analysis rests on two primary conjectures. First, reflecting the diversity of speculations regarding the effects of increased environmental and peer inequality on youth attainments, we have no firm expectation regarding the direction of the impact of increased economic inequality on the level of educational attainment.[1] Second, reflecting the extensive literature on the intergenerational transmission

[1]See Adler et al., 1994; Marmot et al., 1991; Diez-Roux et al., 1997; Kawachi and Kennedy, 1997; Jencks and Mayer, 1990.

of economic status, we expect increases in family and geographic economic inequality when children are growing up to be positively related to disparities in their ultimate schooling attainments.[2]

Mayer (2001) stands as the only empirical exploration of the relationship between family and geographical inequality while children are growing up and attainment patterns in young adulthood. Using data from the Panel Study of Income Dynamics (PSID), she estimated the relationship between state-level economic inequality during adolescence and educational attainment, distinguishing impacts on children from high- and low-income families.[3] The state-specific Gini coefficient of family income at ages 12–15 was estimated using decennial census data, interpolated linearly to obtain a measure for each annual observation. Mayer's control variables included estimated measures of returns to education, region, year, percentage of the state population that was African-American or Hispanic, state-specific mean household income and unemployment rate, log of family income, and a measure of state-specific economic segregation. Mayer found a positive relationship between within-state inequality and both overall educational attainment and inequality in educational attainment. The relationship between the level of educational attainment and state income inequality reflects a greater probability that youths enter college by age 23 in states with more income inequality. Variables reflecting changes in returns to education, parental income, and state-level investments in education are shown to increase youths' educational attainment more among higher-income families than other families.

Our study addresses a similar question, but uses a quite different approach. As we have described, Mayer provided reduced-form estimates of the relationship between parental income inequality (at the

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[2]See Haveman and Wolfe, 1994, 1995; McLanahan and Sandefur, 1994; Haveman et al., 2001.

[3]Mayer's sample of children consists of all observations in the data set at ages 12–14 and ages 20 and 23 (when the relevant educational outcome data were available). Measures of within-state economic inequality and control variables were obtained when the respondents were between the ages of 12 and 14. Mayer considered four educational outcomes: the probability of high school completion by age 20; the probability of beginning college by age 23; the probability of completing four years of postsecondary education by age 23; and the number of years of completed schooling by age 23. High-(low-)income families were defined as families above (below) the median level of family income when children were aged 12–14.

state level) and the level and dispersion of youths' educational attainment. In our approach, we first directly alter family indicators of economic status (e.g., income and assets) and state measures of income inequality and access to higher education to reflect the increased dispersion in these variables. We then simulate the effect on the average level and the dispersion of youths' educational attainments attributable to this increased economic inequality. Our simulated individual educational attainments reflect estimated coefficients from models of attainment that include family economic status, state-specific inequality, and indicators of access to schooling and an extensive number of control variables. Mayer measured family and state characteristics only during the child's adolescent years; we measure these characteristics at nearly all of the child's ages until age 16. Our estimates also reflect the child's experiences in child care, the characteristics of the neighborhoods in which the child grew up, and a direct measure of the state-specific cost of postsecondary schooling.

I. RESEARCH STRATEGY AND DATA

We view the schooling choices of youths to be related to family circumstances and neighborhood environment.[4] We estimate the relationship between educational attainment and family and geographic economic variables (measured during ages 2–15) using a large sample of youths. The family and economic variables in our sparse model are those that our review of an extensive body of research has consistently identified as being significantly related to schooling outcomes (Haveman et al., 2001).

Our basic data set consists of 29 years of information on 2,609 children from the Panel Study of Income Dynamics (PSID). We selected children who were born from 1966 to 1970, and followed them from 1968, the first year of the PSID (or their year of birth, if later) until 1999. Only those individuals

[4]Haveman and Wolfe (1994, 1995) discuss the implications of this framework for empirical estimation. See also Haveman, Wolfe, and Wilson (forthcoming).

who remained in the survey until they reached age 21 are included.[5] Educational outcomes were measured at age 25 (although to limit missing data, some respondents' outcomes were measured as late as age 29). After omitting observations for which information on core variables is missing, we have a sample of 1,210 children.

These data contain extensive longitudinal information on the status, characteristics, and choices of family members, family income, living arrangements, neighborhood characteristics, and background characteristics such as race, education, and location for each individual. In order to make comparisons of individuals with different birth years, we index the time-varying data elements in each data set by age.[6] All monetary values are expressed in 1993 dollars, using the Consumer Price Index for all items. We merged census tract (neighborhood) information describing the percentages of residents that are high school dropouts and that have low incomes from the 1970 and 1980 censuses with our PSID data. The census data are matched to the specific location of the children in our sample for each year from 1968 to 1985.[7] Finally, we merged onto our data estimates of the Gini coefficient on family income in the

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[5]Some persons observed did not respond in an intervening year but reentered the sample the following year. Such persons are included in our analysis, and the missing information filled in by averaging the data for the two years contiguous to the year of missing data. For the first and last years of the sample, this is clearly not possible, and we assign the contiguous year's value, adjusted if appropriate using other information that is reported. Studies of the PSID find little reason for concern that attrition has reduced the representativeness of the sample. See Becketti et al. (1988), Lillard and Panis (1994), and Haveman and Wolfe (1994). A more recent study by Fitzgerald, Gottschalk, and Moffitt (1998) finds that, although "dropouts" from the PSID panel do differ systematically from those observations retained, estimates of the determinants of choices such as schooling and teen nonmarital childbearing generated from the data do not appear to be significantly affected.

[6]Rather than have the information defined by the year of its occurrence (say, 1968 or 1974), this time-varying information is assigned to the child by the child's age, allowing us to compare the process of attainment across individuals with different birth years.

[7]The links between the neighborhood in which each family in the PSID lives and small-area (census tract) information collected in the 1970 and 1980 censuses have been (painfully and painstakingly) constructed by Michigan Survey Research Center (SRC) analysts. For the years 1968 to 1970, the 1970 census data are used in this matching; for the years 1980 to 1985, the 1980 census data are used. In most cases, this link is based on a match of the location of our observations to the relevant census tract or block numbering area (67.8 percent for 1970 and 71.5 percent for 1980). For years 1971 to 1979, a weighted combination of the 1970 and 1980 census data are used. The weights linearly reflect the distance from 1970 and 1980. For example, the matched value for 1972 equals [(.8 x 1970 value) + (.2 x 1980 value)].

individual's state of residence at ages 12–15 (estimated using decennial census data) and the level of tuition/fees at public institutions in the individual's state of residence at ages 17–21.[8]

From these data, we measure three educational attainment outcomes (at age 25) for each young person in our sample—completion of high school, years of completed schooling, and college attendance. We then study the effects of changing the inequality of four family and geographic economic variables—family income relative to needs, family net worth, the state-of-residence Gini coefficient of family income, and the level of state public tuition/fees—on the educational attainments of individuals in our sample.

Table 1 provides unweighted descriptive statistics for all variables included in our models, averaged over the 1,210 observations in our sample. Three-fourths of our sample of youths graduated from high school and 30 percent attended college; they have an average of 12.25 years of completed schooling. The corresponding weighted values are 84 percent (high school graduation = 1), nearly 40 percent (attend college = 1), and 12.63 (years of completed schooling). Unweighted average log of family income/needs is 0.577 (ages 2–5), 0.671, (ages 6–11), and 0.695 (ages 12–15). Unweighted average log of family net worth is 7.621 (ages 2–15). The mean state Gini coefficient at ages 12–15 is 0.375 and the average state public tuition and fees is $1,592.

II. ESTIMATING THE EFFECTS OF FAMILY AND GEOGRAPHIC ECONOMIC CIRCUMSTANCES ON EDUCATIONAL ATTAINMENT

Our estimation of the relationship between the four family economic and geographic economic variables and educational attainments follows the theoretical framework in Haveman et al. (2004). In

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[8]The states' Gini coefficients were provided by Susan Mayer, and are described more fully in Mayer (2001). The estimates of state public university tuition and fees were calculated from state-level data available from the State Higher Education Profile Database, accessible from the National Center for Education Statistics (nces.ed.gov). We would have preferred to include state-specific estimates of public tuition and fees for all individuals at about age 17, when the decision to attend college is becoming particularly pressing, but these data were not available.

assessing the effects of increased inequality of family (income relative to need; wealth) and geographic (state Gini coefficient; state public tuition) circumstances on children's schooling attainments, we first estimate the relationship of these four variables to our three schooling outcomes. The family income variable is measured as the logarithm of the ratio of family income in each year during the individual's ages 2–15 to that year's poverty line; these annual values are averaged over subperiods of the period between ages 2 and 15. The family assets variable is the logarithm of positive family net worth in each year during the individual's ages 2–15; variables indicating negative or missing wealth information are also included. The geographic variables are the state Gini coefficient measured at the individual's ages 12–15 and state public tuition/fees per full-time student divided by 1000, measured in 1987, when the individuals were ages 17–21.

Control variables found to have persistent, robust, and statistically significant relationships with educational attainment in prior research studies (see Haveman et al., 2001) were also included in the estimation. These variables include race, gender, number of siblings, parental schooling, family structure, a foreign-born family head, geographic moves, county unemployment rates, and the percentage of neighborhood or census tract individuals who dropped out of high school. In addition, we include a variable indicating whether or not more than $1,000 was spent on out-of-home child care from ages 2 to 5, as a proxy for having spent extended periods in nonfamily child care. Those variables whose values change over time are averages over the individual's ages 2–15 or over subperiods within this age range.

Estimates from Our Preferred Model

The estimated relationships in Table 2 are generally as expected. Consider, first, the relationship to educational attainments of the family economic variables on which we focus in our analysis of the effects of changing inequality. Family income/needs at ages 2–5 and at ages 12–15 are significantly associated with years of completed schooling and high school graduation. At ages 6–11, the positive relationship between family income and years of completed education is statistically insignificant, and the relationship with high school graduation is negative. Family income/needs is significantly associated with

college attendance only when children are aged 12–15.[9] These results support other research indicating that incomes during early childhood and adolescence are important determinants of educational attainment, and that family income during adolescence is most important in determining college attendance.[10] Family wealth is strongly associated with years of completed schooling and high school graduation, but not with college attendance, suggesting that family net worth affects college attendance through its effect on high school graduation and its correlation with family income.

Second, consider the estimated relationships between the geographic economic variables and educational attainment. Unlike Mayer (2001), we did not find any significant effects of the state Gini coefficients on educational outcomes, either in the Table 2 estimates or those from estimation over high-income and low-income subsamples.[11] As reflected in the interaction terms, the state public institution tuition variable is negatively and significantly associated with high school completion and years of completed schooling for those for whom tuition is measured during the later years of high school, but not with college attendance,[12] suggesting that these schooling costs are related to educational choices when measured close to the last year of high school, and suggesting that if tuition subsidies are to be most

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[9]These effects must be interpreted with caution, however, since the measures of family income at the different ages have correlations ranging from .75 (ages 2–5 and 12–15) to .86 (ages 6–11 and 12–15).

[10]We also estimated a model in which we specified interactions between race and the parental education, income, unemployment, child-care, and tuition/fees variables. Significant racial interactions were found between race and parental education in the models for years of education and high school graduation (suggesting a smaller effect for blacks than for whites), between race and income/needs at ages 6–11 in the model for years of schooling (suggesting a positive effect for blacks and a negative effect for nonblacks), between race and income/needs at ages 6–11 in the model for attending college (suggesting a positive effect for blacks), and between race and income/needs at ages 12–15 (suggesting a positive effect for nonblacks, but almost no effect for blacks). These results are available from the authors.

[11]This difference between our results and those of Mayer are in part due to our smaller sample, but also suggest that the effects of characteristics that have very low correlations with educational outcomes (such as state Gini coefficients) are very sensitive to model specification.

[12]Some factors expected to be related to college attendance are not found to be statistically significant, in part due to estimation over only individuals who have completed high school; some of these variables appear to affect college attendance through their effect on the probability of high school graduation.

effective at encourage additional schooling, individuals and their families should know about them during the high school years, that is, prior to applying for college.[13]

Aside from these family and geographic environment variables, the coefficients of the other variables included in the model are also as expected. Blacks,[14] women, and those from families in which the head is foreign born have higher educational attainment than individuals not in these groups. Parental schooling is positively and significantly related to years of completed schooling and high school graduation. It is not significantly associated with college attendance, as its effect on this outcome appears to be reflected in the estimated effects of family income/needs and wealth. The average number of siblings at home during childhood is negatively associated with years of education and college attendance, but not with high school graduation. The number of residential moves during childhood and the average county unemployment rate are negatively associated with years of completed schooling and high school graduation, but not with college attendance. Interestingly, the proportion of years that a child lives with a single parent is not significantly associated with any of the outcomes after controls. All of the schooling outcomes are negatively associated with the percentage of neighborhood residents with less than a high school degree. There is a suggestion that having spent considerable time in formal child care as a 2–5-year-old is negatively associated with years of completed schooling, though not with high school graduation or college attendance.[15]

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[13]In estimates not reported here, we also included a measure of public school expenditures per pupil, described in Wilson (2001). This required a tradeoff, as the data set to which we could match school expenditures was a slightly different population, namely individuals observed first at age 6. Estimates from this sample, conducted by Kathryn Wilson, suggested a positive, insignificant, and small association between school district expenditures and educational outcome.

[14]This background-controlled effect is a common finding in studies of educational attainment.

[15]This, taken together with the positive effect of income/needs when the child is aged 2–5, suggests that the positive association of educational attainment and income/needs (which is in part a result of greater work effort) may be partly offset by the negative association with time spent in formal child care. The model that includes race interactions suggests the negative association between the extent of formal child care and education outcomes (years of schooling and high school graduation) is significant only for whites.

Estimates from an Alternative Model

We also explore the tie between family economic status and educational attainments in an alternative simpler model in which we include only truly exogenous variables in addition to family income/needs and wealth (see Appendix I). This model could be viewed as more salient for longer-run projections. As expected, the results from this model are consistent with those of our preferred model, but indicate substantially stronger ties between both family income/needs and wealth and our schooling outcomes. For example, the effect of family income/needs at ages 2–5 on years of schooling is about 18 percent higher in the simple model, and about 45 percent higher at ages 12–15. The biggest difference is in the model for college attendance, where both family income/needs at ages 2–5 and wealth are significantly associated with the outcomes. These results both confirm the importance of these family economic variables and suggest that the ties to schooling are stronger when potentially endogenous factors are not included in the model.

III. THE EFFECT OF INCREASED FAMILY AND GEOGRAPHIC ECONOMIC CIRCUMSTANCES ON EDUCATIONAL ATTAINMENT

We assume that our preferred model estimates of the relationships between family economic variables (income relative to need; wealth) and geographic economic variables (state Gini coefficient, state public tuition/fees), on the one hand, and educational attainments on the other are accurate proxies for true causal effects. Then, using the estimated coefficients, we simulate the effect of increased variation (inequality) in the distribution of these variables on the distribution of educational attainments.

The effect on educational attainment of the simulated increase in family and geographic economic inequality is obtained in two steps. In the first step, we increase the standard deviation of each of the family and geographic economic variables by an amount consistent with observed changes in

inequality in the distribution of these variables between 1970 and 1990.[16] We then adjust each simulated value by a constant required to preserve the mean for each variable. In the second step, we use the estimated coefficients from our preferred model (Table 2), together with the adjusted (more unequal) values of the family and geographic economic variables (and the actual values of the remaining independent variables) to predict the value of the relevant schooling attainment outcome for each observation. Our simulated schooling outcomes assume that the supply of available education slots is unconstrained at existing relative prices.[17]

Effects of Increased Economic Inequality on the Distributions of Educational Attainment

Figures 1–3 illustrate the full distributional consequences of the assumed increases in economic inequality based on the preferred model. Each figure includes the relative frequency distribution of predicted actual educational attainment (using actual values of the independent variables together with the coefficients reported in Table 2) and the distributions of predicted attainment based on adjusted (more unequal) values of all four of the indicators of family and geographic economic variables, and on three of these indicators (excluding the state-specific Ginis, whose coefficient is never statistically significant.). By comparing the base distribution (solid line) with the other distributions reflecting the effect of

[16]We estimated these changes in inequality over the period from 1970 to 1990, using several public sources of data. Using published data from the Current Population Survey, we estimated that the standard deviation of family income increased 9 percent between 1970 and 1990, and that the standard deviation of wealth increased about 25 percent. Although the average *level* of public tuition increased fourfold from 1970 to 1990, information on *inequality* among state public tuition levels is difficult to uncover. We used a 10 percent increase in inequality of college tuition at this stage of our analysis, as this value is approximately the increase in tuition inequality between public 4-year universities and 2-year colleges during this time period (from the National Center for Education Statistics). We used state-specific estimates of the change in the Gini coefficient from 1970 to 1990 from the Current Population Survey, and increased the Gini in each state to correspond with the actual change in that state.

[17]In analyzing the impact on the earnings distribution of policies that change the distribution of abilities, Costrell and Loury (2004) examine the comparative statics of mapping ability onto earnings in a model of endogenous job assignment. Because job assignment and, hence, output level are endogenous (additional workers of other ability levels affect the assignment of workers of any ability level, and therefore aggregate output), the net effect of any exogenous policy will differ from the gross effect. Our assumption avoids the complexity of this labor market analysis and the need for a general equilibrium solution; were the supply of education slots not elastic, our analysis would also need to account for the endogeneity of assignment.

increased economic inequality, the expected increase in inequality in educational attainment can be clearly seen. Figure 2, showing the distribution of the probability of graduating high school, indicates the smallest change, consistent with both the Table 2 results and the fact that high school attendance carries no tuition payment and is expected to be relatively insensitive to changes in economic status.

In Table 3, we report both the *average level* (mean and median) and the *inequality* (standard deviation) of the predicted schooling attainment of the children, using the adjusted and more unequal values for the family and geographic variables. We also estimate the simulated proportion of children that fails to graduate from high school and the proportion that fails to complete 11 years of school, using the adjusted variables. We then compare these medians, standard deviations, and proportions with the actual levels recorded in the data. Our results are weighted to reflect national levels of attainment for this cohort of individuals.

The first row in each bank of the table reports predicted actual values of the relevant educational outcomes. The next four rows report predicted values of these outcomes when adjusted (more unequal) values of the four family and geographic economic variables, taken one at a time, are used together with the Table 2 coefficients. The final two rows summarize the predicted outcome values when adjusted values of all four of the changes in family/geographic inequality are assumed, and when all of these changes except the effect of state-specific Ginis are assumed. We note that observed changes in inequality in the distributions of each of these economic and geographic economic variables reflect changes in the same underlying social forces and economic arrangements, and therefore it would be misleading to consider each increase in inequality in isolation from the others. We take the results reflecting the joint change in these variables as summarizing the overall effects of increases in economic inequality on the distribution of educational attainment. Because the state-specific Gini coefficients are very sensitive to model specification, have low correlation with the measures of educational attainment, and typically have t-statistics of less than one in the preferred model (Table 2), we emphasize the simulated effect of jointly increasing inequality of the three economic variables (income/needs, wealth, state public tuition).

The results in the top bank of Table 3 indicate that the increase in inequality of family income/needs and wealth is associated with increases in both the average level (mean and median) and the inequality (standard deviation) of the distribution of years of schooling. For example, the standard deviation of years of schooling increases by approximately 4 percent when the adjusted and more unequal values of income and wealth are substituted for the actual values. These simulated changes also indicate substantial increases in the percentage of individuals who have less than 12 (and 11) years of schooling. In contrast, the simulated increase in the inequality of tuition/fees suggests a small decrease in average years of schooling but no increase in inequality in the years of schooling. The changes in state income inequality are associated with very small changes in both the average and the variation in years of schooling. When we simulate the effects of joint increases in the three family/geographic economic variables, the increase in mean years of schooling is less than 1 percent, while the standard deviation of years of schooling increases by over 8 percent. Because of the simultaneous change in the inequality of all of these economic variables, the proportion of youths likely to complete less than 11 years of schooling increases from about 1.9 to 2.5 percent of that cohort.

Not surprisingly, the middle bank of Table 3 indicates small increases in both the average probability of graduating from high school and in the standard deviation of this probability in response to the increases in family/geographic economic inequality. This is the case both when the effects of the increases in economic inequality are estimated individually or simultaneously. For all of the simulations, the median probability is nearly .9. When the effect of joint increases in the inequality of income/needs, wealth, and tuition/fees is simulated, the standard deviation of the distribution of probabilities increases by about 7.5 percent, reflecting primarily the increase in wealth inequality. [18]

[18]Use of the more parsimonious alternative model indicates effects that are about double the Table 3 estimates.

The results in the bottom bank of Table 3 indicate that the increase in either the inequality of family income/needs or wealth is associated with very small changes (around 1–2 percent) in the probability of attending college. However, when the simulated effect of increasing inequality in three (or four) of the family and geographic economic variables is simultaneously estimated, the mean probability of attending college increases 3–5 percent, and the standard deviation of the distribution of probabilities of attending college increases by about 7 percent.[19]

Overall, these estimates suggest that observed increases in family and geographic economic variables lead to slight increases in the average levels of educational attainment (years of schooling and the probabilities of high school graduation and college attendance) and a more substantial increase in the inequality of attainment—a 7–8 percent increase in the inequality of all of the schooling attainment measures. These estimates are smaller than those revealed in alternative estimates based on the more parsimonious model and similar to those from a model including race interactions. [20]

Effects on Alternative Measures of Educational Inequality

In Table 4, we report the effect of simulated changes in family and geographic economic inequality on measures of schooling inequality that weight differentially changes in various parts of the distributions. These include the ratio of the 90th percentile to the median, the ratio of the median to the 10th percentile, the Gini coefficient, the Theil inequality coefficient, and the Theil entropy index. The 90/50 and 50/10 indicators isolate changes in schooling inequality occurring in the top and bottom tails of the distributions of schooling attainments. The Gini and Theil indicators weight equally changes above

[19]Again, the simpler, alternative model suggests increases in both the mean and standard deviation of the distribution of probabilities that are about double those shown in Table 3.

[20]Simulations using the alternative, more parsimonious model suggest that inequality in average years of schooling increases by about 8 percent due to the observed increases in only income/needs and wealth inequality.

and below the means of the distributions, while the Theil Entropy index applies greater weights to changes in the lower tail of the distributions.[21]

In Table 4, the base levels of the 90/50 and 50/10 measures of inequality are shown in the top two rows of each bank. The indicators for the predicted actual distributions of educational attainment indicate that most of the dispersion of individuals from the median values occurs in the bottom tails of the distributions. The effects of increases in family and geographic economic inequality on the distributions of educational attainment are also concentrated in the bottom tail of the distributions—in virtually every comparison in the table, the 50/10 ratio increases far more than the 90/50 ratio. For example, for years of schooling, the absolute increase in the ratio if all four factors change is 0.006 for the 90/50 ratio, but 0.09 for the 50/10 ratio.

The Gini, Theil, and Entropy indexes are shown in the remaining three rows of each bank. As indicated above, while all are measures of inequality, they differentially weight changes of position within distributions. In the table, we summarize the simulated effects of changing three and four of the indicators of economic inequality. In nearly all of the estimates, joint increases in the inequality of three economic variables (income/needs, wealth, state public tuition/fees) have a greater effect on the inequality of educational attainment than do joint increases in the inequality of four variables (these three and the state-specific Gini coefficient). Again, we emphasize the simulated effect of jointly increasing the inequality of the three economic variables (income/needs, wealth, state public tuition).

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[21]The Gini coefficient is the most common of the indicators, and is sensitive to position changes throughout the distribution. It meets the criteria of mean independence, symmetry, independence from sample size, and Pigou-Dalton transfer sensitivity. The coefficient is not decomposable, and tests of significant differences must rely on bootstrapping techniques. The Theil and Entropy indicators also meet all of these criteria, but they are decomposable. The Entropy measure is sensitive to changes in the lower tail of the distribution, whereas the Theil index is (like the Gini coefficient) balanced in weighting changes across the distribution.

With but one exception,[22] all of the Gini, Theil, and Entropy measures indicate an increase in the inequality of educational attainment due to increases in economic inequality, irrespective of the measure of attainment (the probabilities of high school graduation and college attendance and years of schooling). For the Gini coefficient and the Theil index, increases in the inequality of educational attainment are quantitatively small; substantial changes are recorded for the Entropy index, which places high weight on changes in the lower tail of the distribution. For example, for the high school graduation outcome, the Entropy index increases from .038 to .048, or by more than 25 percent, when the joint effect of increases in inequality of three of the economic variables is simulated.

For all of the indicators, inequality in the probability of attending college is greater than inequality in years of schooling or in the probability of graduating high school. All of these alternative inequality measures indicate a substantial increase in the inequality in the probability of attending college in response to increases in economic inequality. For example, the Entropy index, emphasizing changes at the bottom of the distribution, increases by 17 percent, from .206 to .241, when the joint effect of increases in inequality in three economic variables is analyzed.

Bootstrap tests of statistical significance can be performed for the Gini coefficient, Theil, and Entropy indicators of inequality. While some of the changes in the inequality of the probability of high school graduation and the probability of attending college are quantitatively large, these tests cannot reject the null hypothesis of no change. However, the simulated changes in years of schooling are both quantitatively large and statistically significant at the 90 percent level.[23]

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[22]The exception is the Gini coefficient for high school graduation when all four changes are simultaneously analyzed.

[23]For comparison, we also estimated changes in these indicators of inequality using the simpler, alternative model. The results are statistically significant at the 95 percent level for both years of schooling and college attendance, and suggest substantially larger increases in educational inequality attributable to the increases in economic inequality. These results are shown in appendix 1. We thank Salvatore Barbaro for running the bootstrap tests of significance. These tests utilize bias-corrected and accelerated confidence intervals around the estimators. The intervals are the result of 2000 bootstrap replications and are based on Mills and Zandvakili (1997), Efron and Tibshirani (1993), and Davison and Hinkley (1997).

We conclude from these results that the observed changes in inequality in those indicators that we study imply an overall increase in the inequality of educational attainment for individuals in the subsequent generation, with the loss of educational opportunities concentrated among those with the least schooling.

Race-Specific Effects of Increased Economic Inequality on the Distributions of Educational Attainment

We also estimated our preferred model with a racial variable (black = 1) interacted with parental schooling, income/needs, state public tuition, county unemployment, and child care costs; results are available from the authors. Then, using this model, we simulated the effects of increased inequality in family and geographic economic variables on schooling attainment. Table 5 summarizes the results of our simulations for the two racial groups identified in our sample, whites and blacks.

The base levels of educational attainment are lower for blacks than for whites, irrespective of the measure used. The predicted actual standard deviation of years of education is larger for blacks than for whites, but the reverse is true for the probabilities of graduating from high school and attending college. Estimates of the effects of increases in family and geographic economic inequality (using the results from the joint change in the three key variables—income/needs, wealth, and state public tuition) indicate sizable increases in mean schooling attainment for whites, but either decreases or virtually no change for blacks. The racial schooling gap is enlarged by increases in economic inequality, irrespective of the measure of educational attainment. Using the results for the joint changes in three family and geographic economic variables, the white/black ratio of mean attainment increases from 1.04 to 1.05 (years of schooling), from 1.16 to 1.19 (probability of graduating high school), and from 1.28 to 1.35 (probability of attending college).

Again using the results for the joint change in three economic variables, we find that increases in economic inequality result in increases in the inequality of educational attainment for both racial groups, but the percentage increases are larger for blacks than for whites. For example, the standard deviation of

years of schooling increases by about 7 percent for whites and nearly 9 percent for blacks, and the standard deviation of the probability of graduating high school increases by 4 percent for whites but by 11 percent for blacks.[24]

IV. CONCLUSION

In this analysis we attempt to understand the implications of the increased inequality in U.S. family and geographic economic status for the level and inequality of educational attainment in the next generation. Our approach is distinct from that of Mayer (2001), who studied the relationship of family income inequality at the state level with educational outcomes. We approach the problem by first estimating the determinants of the educational attainments of the current generation of youth, identifying the independent role of family and geographic economic characteristics when they were children. We then simulate the effects of increasing the inequality in the distribution of these characteristics on the distribution of the educational attainments of this later generation of youth.

We estimate that the increase in economic inequality of the magnitude that has been experienced in the United States over the past few decades has intergenerational effects with broad social implications. In particular, our results provide evidence that this increase in family income and wealth inequality has resulted in greater dispersion of educational outcomes, accompanied by a small increase in the overall level of educational attainment. The increased dispersion is primarily because those at the bottom of the educational distribution fall further from the mean; it implies a relative loss of human capital among those who have the least of it. This is reflected in an increased racial gap in educational attainment. Given the

[24]Similar results are obtained from simulations of the effects of increased economic inequality on the alternative measures of inequality, the 90/50 ratio, the 50/10 ratio, the Gini coefficient, the Theil index, and the Entropy index. Of note is a very large increase in the entropy measure for high school graduation for blacks, suggesting a substantial reduction in the probability of graduating for those at the bottom of the distribution because of increased economic inequality. These results are available from the authors.

linkage between schooling attainments and labor market success, the increase in inequality in educational attainments is also likely to be reflected in increased earnings inequality.

Our simulation results appear to be reflected in the actual pattern of changes in educational attainment during past decades. Using data from the Current Population Survey, we estimate that among adults aged 22–25, mean years of schooling have increased by about .035 years from 1979 to 1991, and the standard deviation of years of schooling has increased by 0.08 years, a value that is very similar to our simulated increase 0.07 years.[25]

Our results have implications for public policy. They suggest that the increase in economic inequality we have experienced will be magnified in future increases in economic inequality unless policies are enacted to counter this shift. A variety of measures are available to mitigate growing inequality in family income and wealth, and to increase educational attainments for those youth with few educational opportunities. Increased resources allocated to preschool opportunities for 3- and 4-year-olds can improve school readiness and perhaps increase levels of schooling.[26] Efforts to assist low-income students to obtain postsecondary education also help to alleviate some of the consequences of growing income and wealth inequality. Given the sizable increase in family economic inequality, growing disparities in educational outcomes for the next generation seem inevitable absent additional public intervention.

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[25]These CPS-based values include other changes in the underlying population of U.S. adults aged 22–25, whereas our procedure holds these characteristics constant and models only the changes in income, wealth, state income inequality, and college tuition. The CPS estimates use the final weight as provided by the CPS. We thank Cecelia Rouse, who first suggested this comparison.

[26]See Heckman and Masterov (2004) and Heckman and Krueger (2003).

Table 1
Unweighted Descriptive Statistics

	Obs	Mean	S.D.	Min	Max
High school graduate	1,210	0.749	0.434	0.00	1.00
Attended college	1,209	0.306	0.461	0.00	1.00
Years completed education	1,209	12.251	1.694	2.00	17.00
African American	1,210	0.441	0.497	0.00	1.00
Female	1,210	0.469	0.499	0.00	1.00
Average number of siblings 2–15	1,210	2.101	1.465	0.00	8.43
At least one parent graduated H.S.	1,210	0.633	0.482	0.00	1.00
At least one parent attended college	1,210	0.269	0.443	0.00	1.00
Education info missing for both parents	1,210	0.072	0.258	0.00	1.00
Log of family income/poverty level, 2–5	1,210	0.577	0.639	-2.27	2.79
Log of family income/poverty level, 6–11	1,210	0.671	0.667	-1.48	3.38
Log of family income/poverty level, 12–15	1,210	0.695	0.748	-1.57	3.59
Proportion years with single parent 2–15	1,210	0.270	0.372	0.00	1.00
Number of moves 2–15	1,210	2.831	2.576	0.00	12.00
Head foreign born	1,210	0.020	0.139	0.00	1.00
Average county unemployment 2–15	1,210	6.542	1.910	1.50	30.67
Percent neighborhood dropouts 2–15	1,210	16.708	8.677	0.00	67.29
Log of positive wealth, 1984	1,210	7.621	4.705	0.00	16.12
Negative wealth, 1984	1,210	0.052	0.222	0.00	1.00
Wealth missing, 1984	1,210	0.108	0.311	0.00	1.00
State Gini index 12–15	1,210	0.375	0.019	0.34	0.44
Public tuition & fees per FT student/1000, 1987	1,210	1.592	0.546	0.705	4.78
Public tuition * youngest age group (born 1970)	1,210	0.326	0.693	0.00	4.78
Child care costs above $1000, 2–5	1,210	0.158	0.365	0.00	1.00

Table 2
Regression Results (Preferred Model)

	Years of Completed Schooling	High School Graduation	Attend College†
	OLS Coeff.	**Logit Coeff.**	**Logit Coeff.**
African American	**0.486*** **	**0.599*** **	**0.694*** **
	(0.113)	(0.203)	(0.223)
Female	**0.338*** **	**0.443*** **	**0.554*** **
	(0.096)	(0.123)	(0.147)
Average number of siblings 2–15	**-0.075** **	**-0.057**	**-0.169** **
	(0.039)	(0.059)	(0.061)
At least one parent graduated H.S.	**0.381*** **	**0.764*** **	**-0.007**
	(0.101)	(0.209)	(0.205)
At least one parent attended college	**0.159**	**0.298**	**0.196**
	(0.117)	(0.284)	(0.154)
Family income/poverty level, 2–5, logged	**0.384*** **	**0.616*** **	**0.384**
	(0.107)	(0.190)	(0.267)
Family income/poverty level, 6–11, logged	**-0.168**	**-0.711** **	**-0.097**
	(0.151)	(0.250)	(0.354)
Family income/poverty level, 12–15, logged	**0.336*** **	**0.625*** **	**0.574** **
	(0.127)	(0.218)	(0.241)
Proportion years with single parent 2–15	**0.095**	**-0.078**	**-0.081**
	(0.139)	(0.196)	(0.255)
Number of moves 2–15	**-0.057*** **	**-0.071** **	**-0.040**
	(0.018)	(0.023)	(0.040)
Head foreign born	**1.189*** **	**2.087***	**1.114** **
	(0.448)	(1.292)	(0.743)
Average county unemployment 2–15	**-0.053** **	**-0.094** **	**-0.011**
	(0.025)	(0.052)	(0.038)
Percent neighborhood dropouts 2–15	**-0.024*** **	**-0.030*** **	**-0.029*** **
	(0.006)	(0.009)	(0.010)
State Gini index 12–15	**0.682**	**5.076**	**1.832**
	(3.658)	(5.060)	(4.912)
Log of positive wealth, 1984	**0.050*** **	**0.100*** **	**0.043**
	(0.013)	(0.027)	(0.048)
Negative wealth, 1984	**0.194**	**0.252**	**-0.021**
	(0.154)	(0.282)	(0.612)
Public tuition & fees per FT student, 1987	**-0.036**	**0.261**	**-0.103**
	(0.100)	(0.197)	(0.192)
Public tuition & fees* youngest age group (born 1970)	**-0.154** **	**-0.224** **	**-0.050**
	(0.051)	(0.135)	(0.128)
Child care costs above $1000, 2–5	**-0.210***	**-0.349**	**-0.040**
	(0.122)	(0.204)	(0.200)
Constant	**11.813*** **	**-1.405**	**-1.633**
	(0.221)	(2.051)	(2.332)
Observations	1209	1210	906

Cluster adjusted standard errors in parentheses.
* Significant at 10%; ** significant at 5%; *** significant at 1% †Estimated over those who graduated high school.
Models also include indicator variables for missing information on parental schooling and wealth.

Table 3
Comparison of Predicted Values under Simulated Conditions (Weighted, Preferred Model)

Years of Education	Mean Years	Median Years	Standard Deviation	Percent <12 years	Percent <11 years
Predicted Actual	12.597	12.643	0.816	19.1	1.9
SD of log family income/needs +10%	12.612	12.670	0.848	19.9	2.1
SD of wealth +25%	12.636	12.696	0.852	19.6	2.5
Gini + State change in Gini	12.615	12.668	0.817	19.0	1.9
SD of tuition +10%	12.593	12.639	0.817	19.5	1.9
All four factors changed	12.665	12.727	0.885	19.1	2.5
Three factors changed	12.647	12.706	0.884	19.7	2.5

High School Graduation	Mean Pred Prob	Median Pred Prob	Standard Deviation
Predicted Actual	0.829	0.886	0.161
SD of log family income/needs +10%	0.828	0.888	0.164
SD of wealth +25%	0.833	0.896	0.169
Gini + State change in Gini	0.843	0.899	0.152
SD of tuition +10%	0.829	0.887	0.161
All four factors changed	0.845	0.908	0.164
Three factors changed	0.831	0.898	0.173

Attend College	Mean Pred Prob	Median Pred Prob	Standard Deviation
Predicted Actual	0.428	0.415	0.198
SD of log family income/needs +10%	0.434	0.422	0.207
SD of wealth +25%	0.436	0.428	0.202
Gini + State change in Gini	0.438	0.429	0.199
SD of tuition +10%	0.427	0.416	0.198
All four factors changed	0.450	0.440	0.213
Three factors changed	0.441	0.430	0.212

Table 4
Percentile Ratios, Weighted, and Alternative Inequality Measures (Preferred Model)

	Predicted Actual	All Four Factors Changed	Three Factors Changed
Years of Education			
90/50	1.075	1.079	1.081
50/10	1.102	1.113	1.111
Gini coefficient	0.036	0.039*	0.039*
Theil index	0.002	0.002*	0.002*
Entropy index	0.002	0.0025*	0.003*
High School Graduation			
90/50	1.088	1.074	1.081
50/10	1.532	1.540	1.607
Gini coefficient	0.098	0.095	0.103
Theil index	0.022	0.022	0.026
Entropy index	0.038	0.041	0.048
College Attendance			
90/50	1.676	1.665	1.688
50/10	2.461	2.652	2.708
Gini coefficient	0.264	0.271	0.275
Theil index	0.114	0.121	0.124
Entropy index	0.206	0.232	0.241

* Statistically significant difference from predicted actual at 90% level

Table 5
Comparison of Predicted Values under Simulated Conditions (Weighted, Model with Race Interactions)

Years of Education	Mean Years	Median Years	Standard Deviation	Percent <12 years	Percent <11 years
WHITES					
Predicted Actual	12.686	12.750	0.849	17.3	2.8
SD of log family income/needs +10%	12.704	12.758	0.877	17.2	3.0
SD of wealth +25%	12.731	12.794	0.877	17.5	3.1
Gini + State change in Gini	12.720	12.784	0.851	17.0	2.6
SD of tuition +10%	12.683	12.747	0.850	17.4	2.9
All four factors changed	12.781	12.843	0.908	17.3	2.9
Three factors changed	12.746	12.812	0.906	17.6	3.3
BLACKS					
Predicted Actual	12.141	12.076	0.654	36.9	3.9
SD of log family income/needs +10%	12.121	12.043	0.666	39.2	3.9
SD of wealth +25%	12.135	12.118	0.700	38.6	4.6
Gini + State change in Gini	12.172	12.122	0.651	36.2	3.2
SD of tuition +10%	12.141	12.084	0.654	37.1	4.2
All four factors changed	12.146	12.108	0.708	38.7	4.4
Three factors changed	12.115	12.080	0.712	39.6	4.4

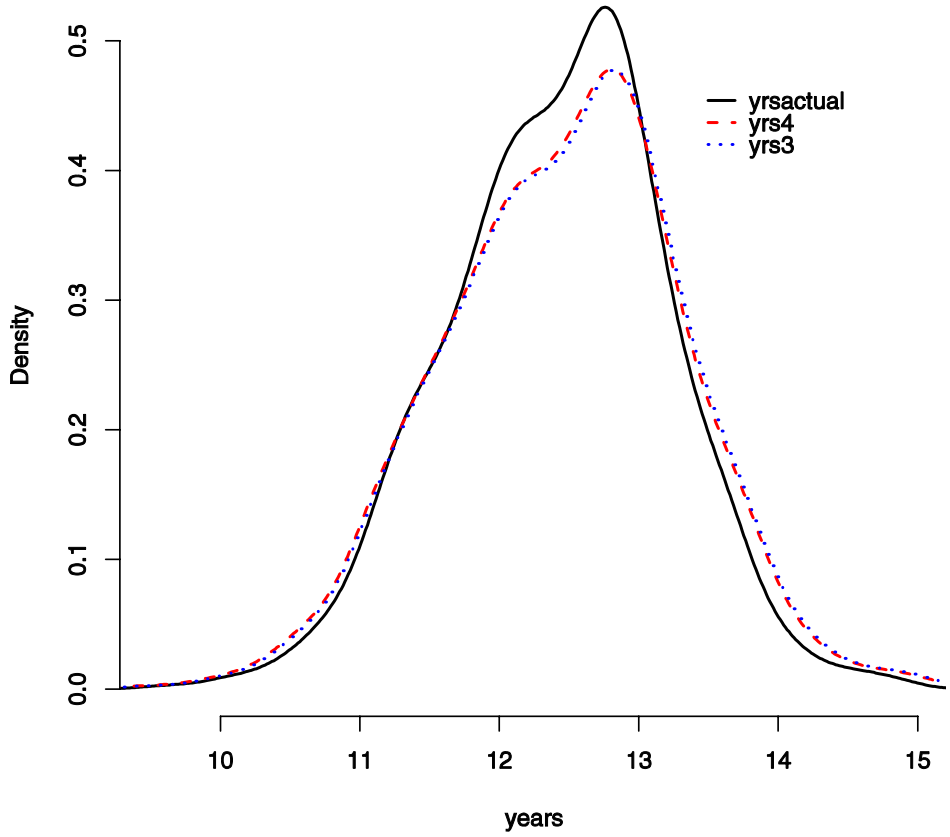
High School Graduation	Mean Pred Prob	Median Pred Prob	Standard Deviation
WHITES			
Predicted Actual	0.848	0.910	0.160
SD of log family income/needs +10%	0.847	0.909	0.163
SD of wealth +25%	0.853	0.917	0.164
Gini + State change in Gini	0.862	0.920	0.151
SD of tuition +10%	0.847	0.909	0.161
All four factors changed	0.866	0.929	0.158
Three factors changed	0.852	0.917	0.167
BLACKS			
Predicted Actual	0.730	0.775	0.174
SD of log family income/needs +10%	0.724	0.769	0.176
SD of wealth +25%	0.722	0.780	0.191
Gini + State change in Gini	0.755	0.790	0.163
SD of tuition +10%	0.730	0.773	0.174
All four factors changed	0.741	0.790	0.181
Three factors changed	0.716	0.773	0.193

(table continues)

TABLE 5, continued

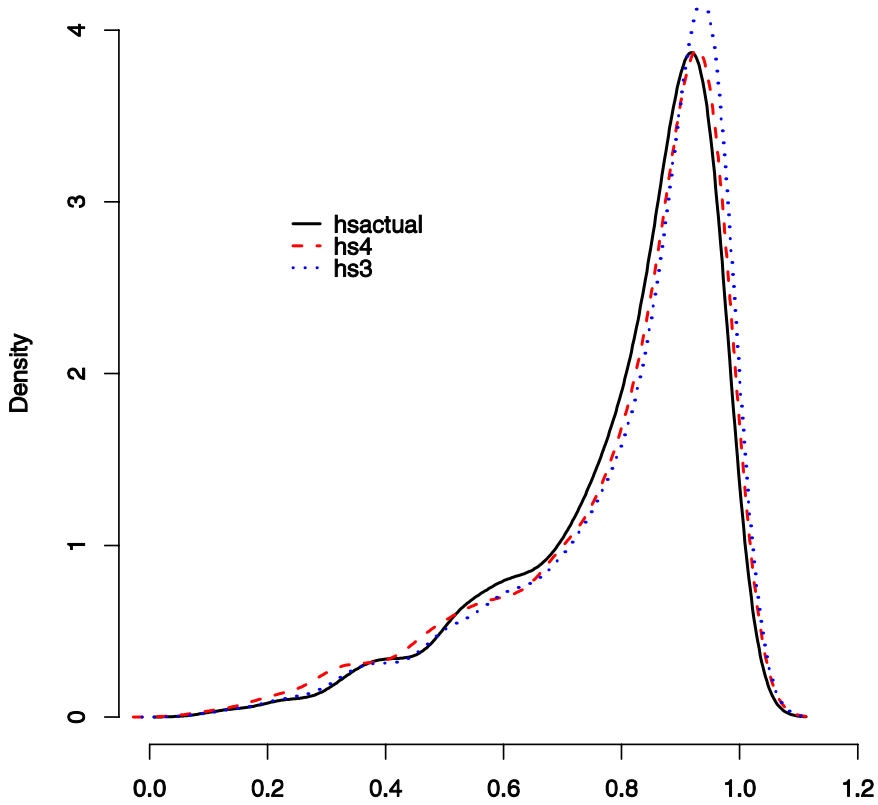
Attend College	Mean Pred Prob	Median Pred Prob	Standard Deviation
WHITES			
Predicted Actual	0.440	0.432	0.198
SD of log family income/needs +10%	0.447	0.439	0.205
SD of wealth +25%	0.450	0.444	0.202
Gini + State change in Gini	0.456	0.447	0.200
SD of tuition +10%	0.440	0.431	0.198
All four factors changed	0.470	0.466	0.211
Three factors changed	0.455	0.452	0.210
BLACKS			
Predicted Actual	0.343	0.293	0.189
SD of log family income/needs +10%	0.335	0.280	0.194
SD of wealth +25%	0.344	0.292	0.195
Gini + State change in Gini	0.356	0.306	0.192
SD of tuition +10%	0.343	0.294	0.189
All four factors changed	0.349	0.288	0.202
Three factors changed	0.336	0.271	0.199

Figure 1



Years of Schooling Distribution

Figure 2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Density
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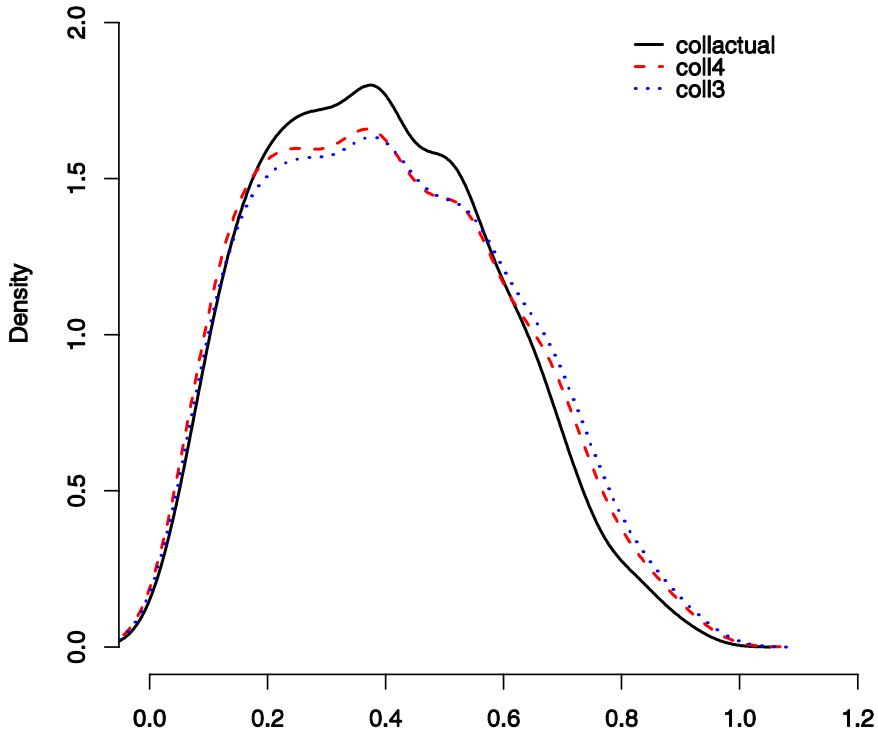
Completion of High School Distribution

Figure 3



College Attendance Distribution

Appendix I
Regression Results (Alternative Model) and Expanded Tests of Inequality

	Years of Completed Schooling	High School Graduation	Attend College
	OLS Coeff.	**Logit Coeff.**	**Logit Coeff.**
African American	0.379***	0.434**	0.538***
	(0.107)	(0.182)	(0.183)
Female	0.321***	0.405***	0.514***
	(0.089)	(0.152)	(0.146)
Family income/poverty level, 2–5, logged	0.452***	0.712***	0.472**
	(0.125)	(0.220)	(0.239)
Family income/poverty level, 6–11, logged	-0.102	-0.646**	0.064
	(0.149)	(0.271)	(0.312)
Family income/poverty level, 12–15, logged	0.488***	0.801***	0.607***
	(0.119)	(0.199)	(0.228)
Proportion years with single parent 2–15	0.093	-0.139	0.185
	(0.143)	(0.232)	(0.256)
Average county unemployment 2–15	-0.070***	-0.100**	-0.027
	(0.021)	(0.039)	(0.037)
Log of positive wealth, 1984	0.067***	0.107***	0.068*
	(0.016)	(0.026)	(0.036)
Negative wealth, 1984	0.269	0.263	0.115
	(0.205)	(0.346)	(0.476)
Constant	11.378***	0.363	-2.214***
	(0.221)	(0.381)	(0.474)
Observations	1209	1210	906

Cluster adjusted standard errors in parentheses. Also included is a dummy variable to indicate if wealth is missing.
* significant at 10%; ** significant at 5%; *** significant at 1%

	Years of Education		High School Graduation		College Attendance	
Inequality Measures	Actual	2 Changes	Actual	2 Changes	Actual	2 Changes
Gini coefficient	0.0289	0.0334**	0.0776	0.0870	0.2303	0.2497**
Theil index	0.0014	0.0018**	0.0134	0.0176	0.0861	0.1020**
Entropy index	0.0014	0.0018**	0.0199	0.0276	0.1359	0.1748**

Appendix 2
Our Simulation Procedure

Our simulations are designed to show what would happen to educational outcomes if our sample had experienced greater levels of inequality in income, wealth, and public tuition costs than they actually experienced. We increase the inequality in these variables as much as it increased in the United States between 1970 and 1990, and then show how growing up in a more unequal society might have influenced the sample's educational outcomes. In order to do that, we first estimate a model using the actual values of our independent variables, and estimate predicted values of the outcome for each individual based on these real variables. For our years of education outcome, for example, each individual has a predicted number of years of education based on their family's actual income and wealth, and their state's actual tuition costs and Gini coefficient.

Then we "spread out" the values of income, wealth, and public tuition (x) in our sample. This is done by adding a given percentage to each value of x that is above the mean, and subtracting the same percentage from each value of x that is below the mean. Using income as an example, we wanted to increase the standard deviation of income in our sample (make it more unequal) by 9 percent, since that was the real change in the standard deviation of the log of family income from 1970 to 1990. In order to do this, each case with income above the mean received a percentage increase in income, and each case below the mean received a percentage loss in income. Then a constant (k) was added to every value to bring the mean of income back to the same value as the initial mean of income.

The same process was used to simulate a 25 percent increase in the standard deviation of wealth, reflecting the real change in the standard deviation of wealth between 1970 and 1990. Real changes in inequality in college tuition proved more difficult to estimate; although the average level of public tuition increased fourfold from 1970 to 1990, information on the inequality of public tuition levels among states is difficult to uncover. Hence, we use a 10 percent increase in the inequality of college tuition, as this value is approximately the increase in tuition inequality between public 4-year universities and 2-year

colleges during this time period. A slightly different process was used for the Gini variable: Gini coefficients already represent inequality, so simply adding a constant to the state Gini coefficients creates a simulated increase in inequality. We have used an estimate of changes in Gini coefficients taken from the Current Population Survey. We changed the Gini in each state to correspond with the actual changes that took place in that state between 1970 and 1990.

After we created these "spread out" distributions of income, wealth, public tuition, and state Gini coefficients, we used the estimated coefficients from the model together with the adjusted (more unequal) values of those independent variables being studied (and the actual values of the remaining independent variables) to predict the value of the relevant schooling attainment outcome for each observation. Again using years of education as an example, we created new predicted values of years of education under the assumption that the overall effect of the variables remained the same (the coefficients from the model remain the same), but with new values of income, wealth, public tuition, and state Gini substituted for each individual in the sample. These new predicted years of education were then compared to the predicted years of education that we find when using actual values of our independent variables.

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