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HUMAN CAPITAL, HEALTH OUTCOMES, AND INEQUALITY[†]

The Health Returns of Education Policies from Preschool to High School and Beyond

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The accessibility of quality schools and educational resources for children are key engines of upward mobility in the United States, holding the potential to break the cycle of poverty from one generation to the next. Inequalities in economic status tend to be correlated across generations in part because of intergenerational correlations in health and education (Rucker C. Johnson 2009). Residential segregation by race and class that leads to unequal access to quality schools is often cited as a culprit in perpetuating inequality in attainment outcomes.

Over the past four decades, three major government interventions have had substantial impacts on the provision of school resources and have narrowed black-white differences in access to dimensions of school quality: i) court-mandated school desegregation, ii) state legislation and legal action aimed to change the distribution and level of school funding, and iii) the expansion of targeted preschool programs for disadvantaged children through Head Start.

Court ordered school desegregation has been described as the most controversial and ambitious social experiment of the past 50 years. Despite the magnitude of these changes, no large scale data collection effort was undertaken to investigate school desegregation program effects, particularly on longer run outcomes. While many prior studies have examined effects of school resources on test scores and more proximate student achievement outcomes, less evidence is available on how school quality influences socioeconomic attainments at mid-adulthood ages using longitudinal data. Similarly, controversy about whether Head Start produces lasting benefits has surrounded the program since its inception. Still fewer studies have documented the relationship of how school resources influence adult health status via impacts on adult socioeconomic status. At the same time, there are large gaps in morbidity and mortality between more- and less-educated individuals, and education has been shown to be one of the strongest correlates of health status; this is true across generations (D. M. Cutler and A. Lleras-Muney 2006).

I. Overview of Data and Empirical Strategy

This paper examines the role of education as the key propeller of upward mobility and highlights its impacts on longer run health. I integrate the analysis of the linkages between educational investment opportunities across the continuum of developmental stages of childhood—including preschool program participation and K–12 school resources—to investigate their long run consequences on adult health outcomes. The study analyzes the health trajectories of children born between 1950 and 1975 followed through 2007 using data from the Panel Study of Income Dynamics (PSID) and its supplements on early childhood education and health, where the data have been geocoded to the Census block

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level. This analysis uses the longest-running US nationally representative longitudinal data spanning four decades linked with multiple data sources containing detailed neighborhood attributes and school quality resources that prevailed at the time these children were growing up.

The primary difficulty in disentangling the relative importance of childhood family, neighborhood, and school quality factors is isolating variation in neighborhood and school quality characteristics that are unrelated to family factors. This paper addresses these issues and investigates the long run consequences of dimensions of childhood school quality on adult health status. In particular, the analysis considers long run consequences of participation in preschool programs such as Head Start, public school quality during adolescence (per pupil spending, class size), K–12 private school attendance, college quality (institution's expenditures per student), and parental and neighborhood expectations for child achievement. I measure school quality as the purchased inputs to a school (per pupil spending; class size; teacher quality; quality of the curriculum). Furthermore, I evaluate effects of advanced placement, placement in special education, grade repetition, and expulsion or suspension from school.

The data and historic policy shift, with the enactment of court ordered school desegregation during the childhood period of these birth cohorts, provide a unique opportunity to evaluate long run impacts of groundbreaking legislation designed to improve school resources for minority children. To this end, I have obtained a comprehensive desegregation case inventory spanning the period from 1954–1990 that contains detailed information on each school district regarding whether there was a court ordered desegregation plan, the year of the initial court order, and type of desegregation court order.[1]

I assess the effects of the court ordered desegregation plans of public schools on adult health outcomes. I exploit the wide variation in the timing of implementation of desegregation plans to identify their effects. The empirical analysis makes two unique contributions by investigating: (i) the effects of court-ordered desegregation plans of public schools on adult health outcomes and attempts to separately identify the effects of neighborhood and school quality, and (ii) the role of childhood school and neighborhood quality in contributing to socioeconomic and racial health disparities in adulthood.

Johnson (2009) presents detailed evidence of how school desegregation influenced the quantity and quality of educational inputs received by minority children. Those results demonstrated a sharp trend break in school resource inputs (per pupil spending, class size, school segregation) immediately following implementation of school desegregation plans, strongly suggesting the estimates reflect the causal impact of desegregation plans.

It is hypothesized that school desegregation may have long run impacts on the adult health status of African Americans through several potential mechanisms: (i) school quality resource effects, (ii) peer exposure effects, and (iii) effects on parental, teacher, and community level expectations of child achievement. The long run effects of each of these hypothesized mechanisms operate in part on how they influence socioeconomic mobility prospects. Because I am able to observe individuals in their 30s, 40s, and into their 50s, I am able to examine the effects of child school quality resources on adult health status through midlife.

Recent research in developmental neuroscience highlights the importance of the preschool years for cognition and setting in place the building blocks of human capital formation. Head Start is a comprehensive, national, federally funded program with significant health components designed to augment the human and health capital of disadvantaged children to better prepare them for subsequent educational experiences. The health components have received less attention in cost-benefit evaluations of the effectiveness of the program.[2] Early-life interventions do not realize their potential long run returns if they are not followed up by quality school investments during the school age years. This underscores the value of the present analysis that considers impacts of both preschool and K–12 educational resources on adult attainments.

[1] This desegregation case data was compiled by The American Communities Project at Brown University.

[2] Prior research has demonstrated that immunizations and physician visits increased among Head Start participants in short run follow-ups. The quality of early care may influence one's ability to make use of later school opportunities and educational supports during school age years.

The rich set of family background controls and unique measures merged from multiple data sources collected on aspects of schools and the physical, service and social environments of childhood neighborhoods help isolate impacts of school quality throughout developmental stages of childhood on subsequent adult health outcomes.[3]

As an alternative empirical strategy, I use sibling comparisons to identify the effects of school quality (including Head Start preschool participation and K–12 school resources) and school desegregation on adult health. This use of sibling models follows research designs previously utilized by Joseph G. Altonji and Thomas A. Dunn (1996) to analyze the effects of school quality on wages and Eliana Garces, Duncan Thomas, and Janet Currie (2002) to examine the long run impacts of Head Start on educational attainment. I estimate within-family effects of school quality inputs on health. The estimated longer-term effects of Head Start come from within-family comparisons of siblings who have and have not participated in the program. Sibling fixed effect models have the advantage of explicitly accounting for observed and unobserved between-family endowment and resource heterogeneity that often plague ordinary least squares estimates.[4] I exploit policy induced changes in per pupil spending and school resources that are unrelated to child family- and neighborhood-level determinants of adult health status.

This identification strategy compares adult health outcomes for individuals who were exposed to integrated schools throughout childhood with health outcomes for their siblings (evaluated at the same age) who grew up in the same communities but who had already reached age 18 prior to the desegregation plan implementation or who were exposed to integrated schools for only a limited period of their childhood, conditional on birth order and year of birth effects.

The key adulthood health outcome examined is general health status (GHS). Self-assessed health status information was collected from household heads and wives in each survey between 1984 and 2007, and was asked of all family members in 1986. GHS is highly predictive of morbidity measured in clinical surveys, and it is one of the most powerful predictors of mortality. In order to scale the GHS categories, I use the health utility based scale that was developed in the construction of the Health and Activity Limitation index. Thus, I estimate interval regression models of adult health status using a 100-point scale where 100 equals perfect health, and the interval health values associated with GHS are: [95, 100] for excellent, [85, 95) for very good, [70, 85) for good, [30, 70) for fair, and [1, 30) for poor health.[5]

II. Main Results

Gaps in adult health between blacks and whites are large. The general health status (GHS) index in adulthood is 6.5 points lower for blacks, on average; but I find substantial birth cohort differences in the magnitude of black-white health disparities in adulthood (evaluated at the same ages) (column 1 of Table 1). In particular, while the age adjusted average black-white difference in adult health status for cohorts born in the early 1950s is 9.3 points, this difference is reduced to 4.7 and 3.3 points, among the cohorts born 1955–1963 and 1964–1968, respectively. These cohort differences are completely driven by health improvements experienced by African Americans over this period; I do not find any significant birth cohort differences for whites. Furthermore, the black-white gap in health status increases in levels and in proportionate terms over the course of adulthood, independent

[3] These include measures of school quality and school segregation, mandated school desegregation plans, parental expectations for child achievement, neighborhood poverty and crime, parental income and education, child health insurance, birth weight, race and residential segregation, health behaviors, housing quality, connectedness to informal sources of support, rate of time preference. These measures are described in detail in Johnson (2009).

[4] There remains some uncertainty about what drives variation across siblings in Head Start participation. Of particular concern is the possibility that participation is related to unmeasured child or time-varying family characteristics that also affect children's subsequent adult outcomes.

[5] The general health status question is: "Would you say your health in general is excellent, very good, good, fair, or poor?" A detailed discussion of the various options for treatment of the GHS variable is described in Johnson (2009). The health utility based scale is currently used by the National Center for Health Statistics to estimate health related quality of life measures and years of healthy life (*Healthy People* 2000).

of year of birth. Indeed, by age 55 the health status of the average African American is problematic, while the average health status of whites at 55 is good or very good (65 versus 85 on the health status index). A quarter of whites report themselves in excellent health well into their 50s; among blacks, the same points are reached before age 40.

The results presented in columns 2 and 3 of Table 1 show models that include child school quality input measures and control for the extensive set of child, family, and neighborhood background factors. For the original sample children born in the early 1950s, I have information on the expenditures per student at the college they attended.[6] Accordingly, column 2 of Table 1 displays regression results for these older cohorts that include the log of the average per pupil school district spending during adolescence and expenditures per student at the college they attended. For individuals born between 1955 and 1975 who were followed through 1995, I have more detailed information on early childhood education and school related measures. Column 3 of Table 1 displays regression results that include this more extensive set of child school quality inputs and other school related measures.

The results in column 2 indicate that a ten percent increase in per pupil school spending during adolescence is associated with a 2.98 point increase in the adult health utility index. Additionally, college attendance is associated with a 3.75 point increase in the adult health utility index at colleges in the top quartile of expenditures per student, and is associated with roughly a 3.3 point increase at colleges in the bottom quartile of expenditures per student. I find similar results for the estimated effects of per pupil school spending during adolescence with the inclusion of preschool program participation and other school related measures (column 3). For purposes of comparison, consider the estimated effects of parental income on adult health, where I find substantially larger impacts of income in the lower tail of the distribution highlighting the negative effects of child poverty. For example, the results in column 3 of Table 1 indicate that a one-unit increase in the family income-to-needs ratio from half of the poverty line to 1.5 times the poverty line translates into a 2.4 point increase in adult GHS (0.5*3.9930+0.5*0.8579), which is equivalent to roughly 8 years younger. The estimated effects of a one-unit standard deviation change in school quality on adult health compare favorably.

Those who attended private schools for the majority of their school age years and those who were placed in gifted or advanced placement classes had significantly better adult health outcomes; while those who exhibited school behavior problems, had to repeat a grade, were placed in special education, or were ever expelled or suspended from school had worse adult health. Differences in child health do not explain these patterns (results not shown).

The results in column 3 show that individuals who attended private preschool programs had better health compared with either those who attended Head Start or those who did not attend preschool. Because unmeasured family differences may cause these estimates to suffer from selection bias, I reconsider these results using identical model specifications, but with the inclusion of the sibling fixed effects in column 4.

The sibling fixed effect results reveal that individuals who attended Head Start had significantly better health outcomes in adulthood compared with their sibling(s) who did not attend preschool. Additionally, the results for the estimated beneficial health effects of private preschool program attendance, while smaller in magnitude than those for Head Start, are robust to the inclusion of sibling fixed effects. Furthermore, individuals who attended schools during their adolescent years with higher per pupil spending as compared with levels that prevailed when their siblings were adolescents experienced better subsequent health outcomes in adulthood (evaluated at the same age). The identification of these effects is driven largely by significant per pupil spending increases in a relatively short period of the 1970s in many areas. I find little evidence that observable differences among siblings are related to differences in the quality of the high schools they attend. There is no evidence that the results are biased by a positive correlation between sibling differences in school inputs and sibling differences in other factors that are favorable to adult health status (robustness checks not shown). I find that the estimated long run beneficial health impacts

[6] This information was appended to the 1975–76 waves of the PSID courtesy of the Higher Education Research Institute, Los Angeles, California, from the USOE's Higher Education General Information Survey.

TABLE 1—LONG RUN EFFECTS OF CHILD SCHOOL QUALITY ON ADULT HEALTH
(*ages 20–57*)
(*Dependent variable: general health status in adulthood*)
Interval Regression Model: 100pt-scale, 100 = perfect health

Childhood school related factors	Raw race gap (1)	Controls for school spending + child *N*hood + fam (2)	Add controls: preschool + school quality (3)	Sibling FE: preschool + school quality (4)	Sibling FE: school desegregation (5)
Preschool years:					
Head Start program participation			–0.1968	1.1763***	
Did not attend preschool (reference category)			(0.7683)	(0.2213)	
Other preschool program			0.8337**	0.5566***	
			(0.4231)	(0.2146)	
School age years:					
Ln(school district per pupil spending) (age 12–17)		2.9752*	2.2589**	1.3032**	
		(1.7805)	(0.8828)	(0.5448)	
School desegregation plan exposure (age 5–17)					–2.0441***
					(0.5363)
School desegregation plan exposure (age 5–17) × black					3.2798***
					(0.6845)
Ever attended private school			0.2264	–1.2586***	
			(0.4359)	(0.3136)	
Proportion of childhood attended private school			2.8768**	–1.4269*	
			(1.1245)	(0.8080)	
Placement in gifted/advanced curriculum			0.7548*	1.1944***	
			(0.4350)	(0.1995)	
Grade repetition			–1.4196**	–0.7856***	
			(0.6908)	(0.2030)	
Placement in special education			–4.6093***	–4.6394***	
			(1.1523)	(0.3274)	
Ever suspended/expelled from school			–1.6575***	–1.0427***	
			(0.4915)	(0.1622)	
Parental low expectations for child achievement		–2.6270*	–1.9203**		
College bound expectations (reference category)		(1.5272)	(0.9004)		
Neighborhood low expectations for child achievement		–1.3868	–1.0733+		
		(1.2782)	(0.6675)		
Expenditures per student at college attended (2000$):					
< $4,000		3.4376***			
Did not attend college (reference category)		(1.1376)			
$4,000–10,000		3.2344***			
		(1.0405)			
> $10,000		3.7513**			
		(1.5527)			
Black born 1970–1975	–4.6319***		–0.9078		
Non-Hispanic white (ref category),	(1.0959)		(1.4610)		
no cohort diffs for whites					
Black born 1964–1969	–3.7636***		0.8680		
Black born 1955–1963	–4.5073***		0.3519		
Black born 1950–1954	–8.8950***	–0.9253			

(*Continued*)

TABLE 1—LONG RUN EFFECTS OF CHILD SCHOOL QUALITY ON ADULT HEALTH (*Continued*)
(*ages 20–57*)
(*Dependent variable: general health status in adulthood*)
Interval Regression Model: 100pt-scale, 100 = perfect health

Childhood school related factors	Raw race gap (1)	Controls for school spending + child *N*hood + fam (2)	Add controls: preschool + school quality (3)	Sibling FE: preschool + school quality (4)	Sibling FE: school desegregation (5)
Age – 30	–0.1966***	–0.2364*	–0.2378***	–0.2532***	–0.2675***
	(0.0206)	(0.1520)	(0.0235)	(0.0115)	(0.0104)
Constant	88.0162***	73.9289***	83.3994***	83.2785***	87.7899***
	(0.4210)	(6.9871)	(2.7643)	(1.2179)	(0.6034)
Sibling fixed effect?	No	No	No	Yes	Yes
Person-year observations	71,780	14,603	45,758	43,393	64,000
Number of individuals	7,111	1,085	4,224	3,984	6,304
Number of families	2,277	779	1,794	1,554	1,762

Notes: All models include controls for age squared, age cubed, gender, year of birth; and columns 2–5 include region of birth, birth order, birth weight, whether born into a two-parent family, parental income and education, child health insurance, parental smoking and alcohol use, and indices intended to capture parental aspirations/motivation and long term planning horizon (rate of time preference proxy), and also include the following controls for neighborhood/housing quality: neighborhood poverty rate, whether high crime, insulation problems, plumbing problems, and connectedness to informal sources of support (coefficients supressed to conserve space). The nonfixed effect models in columns 1–3 are sample weighted to account for the oversampling of blacks and low income families.
Robust Standard errors in parentheses (clustered on individual).
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

of school resources and placement in gifted/advanced classes are thus robust to sibling fixed effects, as are the negative health consequences of school behavior problems (ever expelled/suspended from school), grade repetition, and placement in special education.

The results presented in the final column of Table 1 are sibling fixed effect models designed to assess the long run effects of school desegregation on adult health. I find that black children who were exposed to implemented, court ordered school desegregation for the majority of their school age years experienced significantly improved health outcomes in adulthood as compared with their older siblings who grew up in segregated school environments with weaker school resources (controlling for age and birth cohort effects). Johnson (2009) finds that health outcomes among blacks were particularly affected by changes in access to school resources associated with desegregation, not simply changes in exposure to white students. The results also suggest that whites experienced worse subsequent adult health outcomes (other things equal) among cohorts exposed to school desegregation plans during childhood, except in districts where state funds were used to "level-up" school spending in integrated schools to the level previously experienced only in the white schools.

The estimates imply that, among individuals born between 1955 and 1968, black-white disparities in adult health would not exist if it were not for differences in childhood family, neighborhood, and school quality factors between the racial groups. While the initial raw black-white differences in health among individuals born in the early-to-mid 1950s were significantly larger (as compared with more recent birth cohorts), race differences in childhood family, neighborhood, and school quality factors combined account for about one-half of the black-white health gap among these older cohorts.

All of the school quality measures appear to have stronger relationships with health over time, with stronger links to adulthood health than childhood health and stronger links to health in middle age relative to young adulthood (not shown). The age profile of these estimated effects

suggests that the linkages may be the result of how they influence education and adult earnings, which in turn impact subsequent health. There is also some evidence that measures of school quality inputs steepen the education slope.

III. Discussions and Conclusions

This paper builds upon and extends two strands of literature. The first analyzes the returns to education policies beyond labor market outcomes. The second concerns the inextricable links between school quality and subsequent upward mobility prospects. At the nexus of these two topics, I extend these literatures by providing among the first evidence linking the benefits of school resources to better adult health outcomes.

The results demonstrate that education policies can have substantial effects on future health. Given the importance of local finance in K–12 public education, the impacts that residential segregation has on the distribution of educational resources across public school districts may continue to be significant. Roughly one-third of all elementary schools in the United States have started prekindergarten education programs, but age at entry, access, and quality vary greatly across districts, and many of them are in jeopardy because of uncertain funding (Olson 2002). Perhaps the most effective policies to promote long term health lie outside of traditional health care policy and instead may take the form of education policy. Education policy and programs targeted toward childhood conditions may provide vitally important means to improve population health and reduce health disparities. In this way, education policy is health policy.

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