The Effect of School Quality on Black-White Health Differences: Evidence from Segregated Southern Schools[*]

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Abstract

This paper assesses the effect of black-white differences in school quality on black-white differences in health in later life due to the racial convergence in school quality for cohorts born between 1910 and 1950 in southern states with segregated schools. Using data from the 1984 through 2007 National Health Interview Surveys linked to race-specific data on school quality, we find that reductions in the black-white gap in the pupil-teacher ratio and term length led to reductions in the black-white gap in self-rated health and disability.

Keywords: Education, Health Status, School Quality, Health Disparities

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1. Introduction

It is well-documented that blacks have significantly poorer health outcomes than whites and this pattern has persisted over an extended period of time, in spite of active policy attention to reducing racial differences in health (U.S. Department of Health and Human Services, 2000; Levine et al., 2001; Williams and Jackson, 2005). Much of racial differences in health are hypothesized to result from factors outside the health care system. For example, racial differences in educational attainment explain a significant fraction, but not all, of the racial differences in health outcomes (Williams and Jackson, 2005). However, little is known about the impact of differences in educational quality on racial differences in health. In this paper, we examine the influence of differences in school quality on black-white health differences. This paper builds on a small but growing literature that suggests that school quality may be a significant determinant of later health outcomes.

To estimate the effects of school quality on black-white health differences, we build upon Card and Krueger's (1992) research on racial differences in earnings and examine changes in black and white differences in school quality for cohorts born between 1910 and 1950 in southern states with segregated schools. Throughout the 1900s prior to the desegregation of southern schools in the mid-1960s, there were dramatic reductions in the pupil-teacher ratio and increases in the length of the school year and average teachers' wages in the schools attended by black students and schools attended by white students in the 18 segregated southern states. In this analysis, we construct an index of school quality based on these three measures – the pupil-teacher ratio, length of the school year, and average teachers' wages – because these inputs plausibly influenced the increase of human capital during a year of completed schooling and these measures were the primary components of per pupil expenditures (Margo, 1990). During

this period, there was a significant convergence in school quality between white and black schools as the quality of black schools improved by a greater amount than the quality of white schools (Margo, 1990; Card and Krueger, 1992).

Our empirical approach relies upon the assumption that the racial convergence in school quality within states and over time was conditionally uncorrelated with unobserved variables that also affected the differences in the health status of blacks and whites later in life. This assumption is premised on previous research which suggests that the determinants of the convergence in school quality during this time are primarily the historical demographics of the state, which led to litigation and private philanthropy that improved the quality of schools attended by black students, all of which are plausibly unrelated to health disparities more than 30 years later except through changes in school quality (Margo, 1990; Card and Krueger, 1992; Donohue, Heckman, and Todd, 2002).

We model black-white differences in health outcomes measured between 1984 and 2007 using data from the National Health Interview Surveys (NHIS). Using the restricted-access files, we link the NHIS data to average measures of the pupil-teacher ratio, annual teacher pay, and length of the school year for black and white schools in southern states from Card and Krueger (1992). We use race-, state-, and birth cohort-specific data on infant mortality rates from vital statistics records and average family size and socioeconomic characteristics constructed from the decennial Censuses to control for other factors that may have been correlated with changes in black-white school quality and black-white health outcomes later in life.

We find robust evidence that reductions in the black-white gap in school quality led to reductions in the black-white gap in disability and suggestive evidence of reductions in the black-white gap in self-rated health. Both of these results are robust to controlling for race-

specific proxies for local health and socioeconomic conditions that prevailed at the time when individuals were attending school. We do not find an effect on the black-white gap in body mass index, smoking, or mortality. This project provides some of the first evidence of the influence of improvements in school quality on long-run population health disparities.

2. Background

It is well-documented that blacks have significantly poorer outcomes than whites in the U.S. for most health and health behavior indicators. These racial health differences are hypothesized to be due to a number of factors, including racial differences in socioeconomic status.[1] In particular, educational attainment has been shown to explain a substantial proportion of racial differences in health, although the magnitude of that proportion varies depending on the health outcome and population (Guralnik et al. 1993). This paper considers the relationship between racial differences in school quality and long-run racial differences in health.

Fundamental to understanding how racial differences in school quality affect racial differences in health is understanding how school quality might affect health in the first place. Conceptual models of health posit that more human capital makes individuals more knowledgeable about promoting and maintaining their health, and more effective at acting on that knowledge (Grossman 1972). Within the context of this model, school quality may affect health through several distinct mechanisms. First, improvements in school quality may lead to increased educational attainment (Card and Krueger, 1996), and there is evidence to suggest a

[1] Many explanations for the causes of racial differences have been explored, including physician discrimination (Balsa and McGuire, 2003), sorting of races into different quality health care providers (Baicker, Chandra, and Skinner 2005), the availability and type of insurance (Currie, Decker, and Lin 2008; Balsa, Cao, and McGuire 2007), patient compliance with therapy (Simeonova 2008), medical knowledge (Aizer and Stroud 2010), residential segregation (Williams and Jackson 2005), income (Williams and Jackson 2005), and education (Williams and Jackson 2005).

causal effect of educational attainment on health (Lleras-Muney 2005). Second, improvements in school quality may increase the marginal health returns to schooling. This may occur if better quality schooling leads to greater marginal improvements in cognitive or noncognitive skills that matter for health outcomes, relative to lower quality schooling. In addition, if better quality schools increase the marginal returns to schooling in terms of wages or occupational status, there may also be increased marginal health returns as income and occupational conditions are hypothesized to affect health. For example, Frisvold and Golberstein (2011) find that for southern-born blacks, improvements in school quality increase the marginal health returns to schooling for a number of health and health behavior outcomes. Thus, to the extent that there are differences in school quality between blacks and whites, one might expect there to be resulting health differences between blacks and whites.

Our research focuses on changes in school quality that happened in the southern U.S. in the early to mid-20th century. This was an era of racially segregated schools – although Brown vs. the Board of Education in 1954 ruled that "separate but equal" schools were unconstitutional, for the most part schools remained segregated until the Civil Rights Act of 1964 (Ashenfelter, Collins, and Yoon, 2006). Three points about southern segregated schools are particularly salient. First, on average, white students attended schools that had far greater quality than black students. This disparity existed, in large part, because blacks were disenfranchised from school finance decision-making (Margo, 1990). Following the Reconstruction period, blacks were disenfranchised throughout most of the South, allowing whites to appropriate more of their states' total school resources to themselves, which increased the quality of white schools and increased the demand for schooling among whites (Margo, 1990).

Second, between 1915 and 1966 there was an overall convergence of school quality between blacks and whites. Although school quality in the South improved in white schools following the Reconstruction period in the late 1800s, it was not until around 1915 that school quality improved for black schools in the South (Margo, 1990). After 1915, measures of school quality improved for both whites and blacks, and blacks experienced relatively greater improvements than whites. For example, Card and Krueger (1992) document that in 1915 the average pupil-teacher ratio in black schools was 61, while it was 38 in white schools. By 1966, the average pupil-teacher ratios had nearly converged (26 for black schools and 24 for white schools). Based on data from Card and Krueger (1992), Figure 1 displays the convergence in the pupil-teacher ratio, teachers' wages, and the length of the school year between 1915 and 1966, which are three commonly used proxies for the quality of schooling in the early- and mid-twentieth century. As shown in the graph, the convergence in the pupil-teacher ratio was reasonably constant, with the largest decline occurring in the 1920s, while the convergence in the length of the school year occurred most dramatically in the 1930s and the majority of the convergence in teachers' wages occurred in the 1940s.

Third, the aggregate trend of racial convergence in school quality masks considerable variation in black-white school quality both across southern states and over time (Margo, 1990; Card and Krueger, 1992, 1996). For example, in 1916, the pupil-teacher ratio was 37 for whites and 72 for blacks in South Carolina. On the other hand, in North Carolina the pupil-teacher ratio was higher for whites at 41 but lower for blacks at 47 students per teacher (Card and Krueger, 1996). Figure 2 displays the variation in school quality differences across states and over time by showing the black minus white average pupil-teacher ratio for all southern states in 1920, 1940, and 1960. In 1920, Alabama, Florida, Louisiana, Mississippi, and South Carolina each

averaged 20 more students per teacher in black schools than white schools. By 1960, this difference was reduced almost to zero in Alabama and Florida. The difference in the pupil-teacher ratio in Arkansas, Georgia, and Virginia was about 15 students in each state in 1920, but by 1960, the difference has fallen to about 2 students in Georgia and Virginia while it had fallen to only 7 students in Arkansas. Thus, there is considerable variation in racial school quality differences across states and over time and this is the variation that we focus on in this paper.

Key reasons for the convergence in school quality throughout the South were private philanthropy from the North (and specifically from the Rosenwald Fund) and the National Association for the Advancement of Colored People's (NAACP) legal campaign to enforce "separate but equal" standards, both of which were directed towards states with the highest percentages of blacks in the population (Card and Krueger 1992; Donohue, Heckman, and Todd 2002).[2] In an effort to maximize the impact of the contributions, the Rosenwald Fund targeted states that provided the least amount of funding to black school districts (Donohue, Heckman, and Todd, 2002), which were the states with the historically highest proportion of blacks in the population.[3] After achieving early victories in Maryland and Virginia, the NAACP targeted states with the most unequal financing between black and white schools, which violated the equality provisions of the separate-but-equal doctrine established in *Plessy v. Ferguson* (Donohue, Heckman, and Todd, 2002); these states were the seven states with the highest percentages of blacks in the population around the turn of the century.

[2] As noted by Donohue, Heckman, and Todd (2002), migration from urban to rural areas within the South explains little of the convergence in school quality between blacks and whites.

[3] The Rosenwald Fund provided matching grants to build schools and required minimum standards for teachers' wages and the length of the school year in order to receive funding (Donohue, Heckman, and Todd, 2002). Thus, the Fund required commitment from blacks in the local communities, which could reflect preferences for education; however, Aaronson and Mazumder (2010) find that the socioeconomic conditions of blacks are unrelated to the locations of Rosenwald schools. Since the Rosenwald Fund contributed to the building of new schools, the improved sanitation in these new schools could be correlated with the improvements in school quality for blacks during the 1920s.

Thus, as described by Margo (1990) and Card and Krueger (1992, 1996), the primary determinant of the variation in school quality both across states and within-states over time was the relative historical size of the black population in the state, which influenced the timing and location of Northern philanthropy and the NAACP's legal actions. For example, Card and Krueger (1996) note that the percentage of the population that was black was nearly twice as high in South Carolina compared to North Carolina. The relative size of the black population in southern states in the early 1900s was primarily determined by the differing use of slave labor across states based on the type of crops farmed, and thus the geography and weather of the state (Fogel and Engerman, 1974; Wright, 1986; Cooper and Terrill, 1991; Card and Krueger, 1992, 1996).[4]

Prior research investigates the role of school quality in explaining racial differences in income. Card and Krueger (1992) study within-state over time variation in state-level school quality and find that the convergence in school quality between blacks and whites born in the South between 1910 and 1950 led to a significant convergence in the racial wage gap for working males. More recently, Aaronson and Mazumder (2010) study the effect of the expansion of Rosenwald schools in the South that played an important role in improving school quality for blacks. They find that the expansion of these schools led to gains in educational attainment, cognitive skills, and wages for blacks relative to whites.[5] Finally, Johnson (2010) studies the effects of racial differences in school quality that emerged out of the timing of school desegregation for the 1950-1970 birth cohorts. He finds that the racial convergence in school quality led to a convergence in years of schooling, earnings, and self-rated heath (the only health

[4] Cotton, which relied significantly on slave labor, was the primary crop in the states with relatively large black populations, while tobacco was the primary crop in states with relatively smaller black populations (Fogel and Engerman, 1974; Wright, 1986).

[5] They also find that it increased the probability of blacks migrating to the North after completing their schooling, relative to whites, motivating our reduced form empirical approach, where we do not condition on migration.

outcome he observes). We build on this previous research by examining the influence of the convergence in school quality among segregated schools in the South on a variety of long-run health behaviors and outcomes.

3. Econometric Strategy

To assess the impact of differences in the quality of schools attended, we compare the average health outcomes of blacks and whites who were born in the same state in different cohorts and experienced differences in school quality. Specifically, we estimate regression models with the following specification:

$$H^{b}_{sctg} - H^{w}_{sctg} = \beta\left(Q^{b}_{sc} - Q^{w}_{sc}\right) + \phi_c + \mu_t + \delta_g + \varepsilon_{sct}, \quad (1)$$

where H^{b}_{sctg} is the average value of the health measure for blacks born in state *s* in the South of cohort *c* measured at time *t* of sex *g*, H^{w}_{sctg} is the corresponding measure for whites, Q^{b}_{sc} is the average school quality for black schools in state *s* of cohort *c*, Q^{w}_{sc} is the corresponding measure for white schools, ϕ represents cohort fixed effects, μ represents survey year fixed effects, δ represents a dummy for sex, and ε denotes random error. We focus on cohorts born between 1910 and 1950 in the 18 segregated states in the South and examine health outcomes measured between 1984 and 2007. The parameter of interest is β, which is identified from changes over time in state-specific and cohort-specific differences in quality between black and white schools.

By focusing on within-state over-time variation in the difference in school quality for blacks and whites, we control for time-invariant state and region characteristics that influence health as well as all time-varying state characteristics that influence the health of blacks and whites similarly. As noted by Card and Krueger (1992), taking the black-white difference on

both sides of equation (1) is equivalent to a specification that includes state-by-cohort-by-survey year fixed effects. Nevertheless, given the social changes that occurred in the South during this period, there is a possibility that black-white changes in school quality could have been correlated with black-white changes in contemporary conditions that may have affected health later in life. Thus, our models also include the black-white difference in state- and cohort-specific measures of infant mortality rates (IMR) as a measure of black-white differences in contemporaneous health conditions. IMR is a useful covariate for several reasons. First, IMR has been shown to be sensitive to changes in local health care resources (Almond, Chay, and Greenstone, 2009) and environmental conditions (Chay and Greenstone, 2003), implying that if there were changes in health care resources or environmental conditions that were correlated with changes in school quality and might affect health later in life, we would expect it to be reflected in IMR. Second, IMR is also responsive to social and economic conditions (Fishback, Haines, and Kantor, 2001), implying that if there were changes in social or economic conditions that may have been correlated with changes in school quality, we would also expect that to be reflected in IMR. Further, we also include the black-white differences in state- and cohort-specific measures of socioeconomic status that might be correlated with the demand for school quality, which are measured by average family size and the average Duncan SEI occupational earnings score. Thus, we augment equation (1),

$$H^b_{sctg} - H^w_{sctg} = \beta\left(Q^b_{sc} - Q^w_{sc}\right) + \gamma(I^b_{sc} - I^w_{sc}) + \pi(X^b_{sc} - X^w_{sc}) + \phi_c + \mu_t + \delta_g + \varepsilon_{sct}, \quad (2)$$

where I^b_{sc} and I^w_{sc} are the state-specific, cohort-specific infant mortality rates for blacks and whites and X^b_{sc} and X^w_{sc} are the state-specific, cohort-specific measures of socioeconomic status for blacks and whites.

Equation (2) represents our preferred specification. In order to bias our estimates of β in equation (2), there would need to be unobserved variables that affect health later in life, vary within states and over time in a way that is correlated with the changes in black-white school quality, and are uncorrelated with changes in the black-white difference in IMR or socioeconomic status. Historical evidence does not suggest that based on these conditions, β will be biased. For example, the geographic patterns of convergence in school quality are not correlated with the introduction of food programs in schools (Mazumder, 2007), vaccination requirements for school attendance (Mazumder, 2007), the establishment of state boards of health (Cooper and Terrill, 1991), or increases in the number of black hospitals (Rice and Jones, 1994). The introduction of water filtration and chlorination systems in major U.S. cities between 1900 and 1936 reduced infant mortality and there is some evidence that suggests that minority neighborhoods received clean water later than white neighborhoods, although there is no evidence that the local introduction of this technology mirrored local school quality changes (Cutler and Miller, 2004; Troesken, 2002). Nevertheless, we control for black and white differences in infant mortality rates to reduce the possibility that this public health initiative or any other improvement in public health biases our results.

Four major diseases that were prominent in the South were largely eradicated in the first half of the 1900s were yellow fever, pellagra, malaria, and hookworm (Humphreys, 2009). Hookworm eradication in the South during the first decades of the 1900's has been shown to have affected human capital accumulation, and has also been shown to have had greater effects on black populations than white populations (Bleakley 2007). Unfortunately, data on hookworm prevalence and eradication are not available at the state and race level over our study period, preventing us from directly including it as a covariate. To further examine whether our estimates

of the influence of changes in school quality reflect changes in the health conditions among states, we examine the robustness of the results from equation (2) to excluding states most affected by the hookworm eradication campaign in the early 1900s. In these models, since hookworm was largely eradicated by 1930, we exclude the 1910-1929 birth cohort observations from the six states with estimates of hookworm prevalence in 1918 that was at least 25 percent.[6]

We also examine the robustness of our results to bias from selective mortality. If the convergence in school quality affects racial differences in mortality, then the health of the surviving population would differ from the health of the population in the absence of the effect on mortality. Since the bias from selective mortality should be most severe among older cohorts, we examine the sensitivity of our results to excluding the 1910 cohort.

Further, as noted above, prior research finds that improvements in school quality for southern-born blacks relative to whites led to a convergence in the black-white difference in income (Aaronson and Mazumder 2009; Card and Krueger 1992). Since income is hypothesized to be an important determinant of health (see Meer, Miller, and Rosen (2003) for a discussion and review), we examine whether our results are mediated by family income. To do this, we modify equation (2) by adding a term for the black-white difference in average current family income (*Y*) as measured in the NHIS:

$$H^{b}_{sctg} - H^{w}_{sctg} = \beta\left(Q^{b}_{sc} - Q^{w}_{sc}\right) + \gamma(I^{b}_{sc} - I^{w}_{sc}) + \pi(X^{b}_{sc} - X^{w}_{sc}) + \delta(Y^{b}_{sc} - Y^{w}_{sc}) + \phi_c + \mu_t + \delta_g + \varepsilon_{sct}.^{7} \quad (3)$$

This exercise has several important limitations, including the potential endogeneity of average family income and the lack of a better measure of permanent income, such that we view the results of equation (3) as merely suggestive of the potential influence of income. Building on

[6] The six excluded states are Alabama, Florida, Georgia, Louisiana, Mississippi, and North Carolina. The prevalence estimates, which are also used in Bleakley (2007), are reported by Kofoid and Tucker (1921) and are based on a survey of army recruits.

[7] This exercise is similar in spirit to the investigation of the mechanisms linking years of schooling and health behaviors in Cutler and Lleras-Muney (2010).

recent research that finds that improvements in school quality for southern blacks increased the probability of migrating to the North (Aaronson and Mazumder 2011) and that migration from the South to the North during adulthood led to an increase in mortality (Black et al., 2011), we also estimate a specification similar to equation (3) that controls for the black-white difference in the state-specific, cohort-specific percent of individuals who currently reside outside of the South to examine whether emigration can partially explain the impact of school quality.

As a final note, all of our regression models are weighted by the total number of observations (both black and white) represented by each cell, and we estimate all models with heteroskedasticity-robust standard errors clustered on the state of birth.

4. Data

Our data come from the 1984 through 2007 National Health Interview Surveys (NHIS). The NHIS is conducted annually by the National Center for Health Statistics and collects extensive survey data on health status and sociodemographic information. The NHIS is nationally-representative, and has large sample sizes, collecting data from between 60,000 and 120,000 individuals per year between 1984 and 2007. We use the restricted-use versions of the NHIS, which allows us to link respondents with their state of birth and with detailed mortality information. The state of birth data are self-reported, and the mortality data track mortality status through the end of 2006 from the National Death Index. State of birth was not collected prior to 1984.

We restrict our sample to include only blacks and whites who were born between 1910 and 1950 in southern states.[8] We then aggregate the data into cells for analysis of black-white differences in health outcomes. We aggregate the data based on race, sex, state of birth, 10-year birth cohort (1910-1920, 1921-1930, 1931-1940, 1941-1950), and NHIS survey year (using four 6-year categories). Within each cell, we take the mean of our health outcome variables, the IMR covariate, and our school quality variables (described below), and then take the difference between the analogous cell means between blacks and whites. After dropping cells with fewer than 10 blacks and 10 whites, we are left with 462 cells for our analyses.

We focus our analyses on several domains of health outcomes. The first domain is mortality, where the dependent variable is the black-white difference between the proportion of individuals who died by the end of 2006. Our second domain is general health status. We first look at the black-white difference in the cell mean of the 5-level self-rated health measure (1=excellent health, 5=poor health). We also test for whether school quality affects black-white differences in self-rated health at different points of the self-rated health distribution by looking at the black-white differences in the proportion reporting excellent or very good health, and in the proportion reporting fair or poor health. Our third domain is disability, where the dependent variable is the black-white difference in the proportion reporting any activity limitations due to chronic health conditions. Our fourth domain is weight-related outcomes. We look at the black-white difference in mean BMI, and also in the black-white differences in proportions obesity(BMI>30). Our final domain is smoking behavior, where we look at black-white differences in the proportion reporting that they ever smoked (whether respondents smoked at least 100 cigarettes in their lifetime) and in the proportion reporting being a current smoker.

[8] The southern states in our sample include Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

We construct a single index of school quality using factor analysis that is derived from three measures of school quality: average pupil-teacher ratio, average term length (measured in days per school year), and average teacher wages (expressed in 1967 dollars) for grades K-12 in public schools.[9] These measures are used in Card and Krueger (1992) and are derived from data in the Biennial Surveys of Education, state education reports, and annual reports from the Southern Education Reporting Service.[10] Due to the segregated nature of schools in the South between 1915 and 1966, these school quality measures are available separately for black and white students. To construct the individual measures of educational quality, we follow Card and Krueger (1992) and use data from the 1970 census to derive the average of the quality measures based on the years that each individual in each race-state-cohort attended school, which is determined based on the number of years of schooling attended, state-of-birth, and the year in which the individual was 6 years old. These values for individuals are then averaged to determine the school quality for each cohort within each state.[11] We then construct an index of overall school quality based on these three measures using factor analysis. We retain the one factor with a positive eigenvalue, which has positive factor loadings for teachers' wages and

[9] The average number of days per school year could be viewed as a measure of the quantity of schooling; however, as noted above, we consider term length as a measure of school quality because the number of days per school year is a determinant of the amount of human capital gained within a year of completed schooling.

[10] We thank David Card for providing the detailed data used to construct the 10 year averages published in Card and Krueger (1992), which include state averages for 1915 and biennially from 1918 to 1966.

[11] Card and Krueger (1992) note that the average teacher wages reported in the school quality data are nearly identical to the state- and race-specific average wages for teachers in the 1940, 1950, and 1960 Census; however, the authors acknowledge the possibility of measurement error in these data, particularly in the early years. Since the school quality measures are assigned to individuals based on their years of schooling attended and then aggregated for each cohort in each state, the school quality measures are weighted averages of 20 years of school quality data, which reduces the influence of measurement error from a specific year. Related to measurement error concerns, the average pupil-teacher ratio is based on enrollment, instead of attendance, so that these reported statistics may not accurately reflect the number of students present in a classroom. As noted by Card and Krueger (1996) and Heckman, Layne-Farrar, and Todd (1996), the use of state-level measures of school quality could reduce the attenuation bias from school-level measures of school quality that are potentially measured with error or that do not reflect the quality of schooling received throughout all years of schooling. Further, as described by Donohue, Heckman, and Todd (2002), the use of state averages of school quality masks variation in school districts within states, which will lead to a downward bias in the estimated impact of school quality.

term length and a negative factor loading for the pupil-teacher ratio, and is consistent with the factor variable reflecting an overall indicator of school quality. The magnitudes of the factor loadings for all three measures are similar (although the factor loading is slightly weaker for teacher wages than pupil-teacher ratio and term length), implying that the three measures are reasonably correlated with each other, and that the variation in the summary measure reflects the variation in all three measures. We report the results for this single index in the main tables below.[12] Using this summary measure of school quality has two main advantages: it provides a less-noisy measure of the underlying school quality construct than the individual school quality measures, and it reduces the number of statistical tests in our analyses by two-thirds. For transparency, we also include the regression results based on each separate quality measure in the appendix table.

We also include the black-white differences in infant mortality rates (IMR) and socioeconomic status as covariates in our models. The IMR data are state-, cohort-, and race-specific, and collected from U.S. vital statistics records and are publicly available in various years of the Statistical Abstracts of the United States and Vital Statistics of the United States. For cases where there are missing IMR data and it was possible to interpolate, we did so using linear interpolation. In our analyses, we consider the state-, cohort-, and race-specific IMR when each cohort was six years old as a proxy for the stock of health resources that were available when cohorts were entering school, with the understanding that there are numerous inputs to health stock, including access and quality of health care, along with social, economic, and

[12] The scoring coefficients for the summary measure of school quality indicate that term length receives the most weight (scoring coefficient=0.45), followed by pupil-teacher ratio (scoring coefficient=-0.39), and teacher wages (scoring coefficient=0.17). The "uniqueness" of the three individual school quality measures are 0.194 for pupil-teacher ratio, 0.396 for teacher wages, and 0.171 for term length, indicating that the summary factor measure explains most of the variance in all three individual school quality measures.

environmental inputs.[13] We include the state-, cohort-, and race-specific average family size and average Duncan SEI occupational earnings score and measures of socioeconomic status, which are derived from decennial census data (Ruggles et al., 2010) and are constructed by linearly interpolating these measures for the years between the decennial censuses.

Table 1 documents the school quality and health measures for blacks and whites and the differences between the two races among individuals born between 1910 and 1950 in the segregated southern states. On average, blacks attended schools with five more students per teacher, with teachers who were paid almost $500 less (in 1967 dollars), and with a school year that was 6.5 days shorter than among schools attended by whites. The average summary measure of school quality is 0.566 lower for blacks than whites, and the standard deviation of the black-white difference in school quality is 0.726. Blacks are also disadvantaged, compared to whites, for nearly all health measures. For example, blacks are more likely to be limited in their daily activities, have a higher average BMI, have a BMI that is higher throughout the right side of the BMI distribution, are more likely to currently smoke, and have lower quality self-reported health.

5. Results

Table 2 displays the estimates of the effect of black-white school quality differences on black-white health outcomes as in equation (1) along with our preferred estimates of the effect net of trends in racial differences in infant health and socioeconomic status from equation (2). As shown in the first row of Table 2, an improvement in school quality improves the self-rated health of blacks, relative to whites. A one unit increase in the school quality index for blacks, relative to whites, improves the self-rated health of blacks by 0.07 more than whites and this

[13] The results reported below are the same or slightly stronger if we control for IMR at birth as opposed to age 6.

result is robust to the inclusion of additional covariates in equation (2). Thus, a one standard deviation increase in the black-white school quality index of 0.73 would decrease the racial differences in self-rated health by 0.051, which is one-quarter of the standard deviation in black-white differences. The results displayed in the following rows of Table 2 demonstrate that this relationship occurs throughout the distribution of self-rated health, where relative improvements in the quality of black schools lead to relative increases in the likelihood of being in excellent or very good health and decreases in the likelihood of being in fair or poor health for blacks.

A relative improvement in school quality decreases BMI and obesity for blacks, relative to whites based on the specification of equation (1); however, these results are not robust to controlling for black – white differences in the infant mortality rate and socioeconomic conditions. Similarly, the results for having ever smoked and current smoking status are not robust across the different specifications. It is notable, however, that the results from equation (1) suggest that the convergence in school quality led to a divergence in ever smoking, and conditional on that divergence, a convergence in quitting among those who ever smoked. This pattern, though not robust to including socioeconomic covariates, is consistent with other research suggesting that more schooling was associated with more smoking for cohorts that completed their schooling before smoking risks were widely-known, and the educational differences in smoking only emerged after the Surgeon General's 1964 warning about the dangers of tobacco use (de Walque 2010).

Relative improvements in school quality are related to differences in disability status. In the preferred specification, a one unit increase in the school quality index of black schools, relative to white schools, reduces the likelihood of having a disability for blacks by 0.025 more than whites. While statistically significant, this effect is modest in magnitude. A one-standard

deviation reduction in the black-white school quality gap leads to a 0.18 standard deviation decrease in the black-white gap disability gap. Finally, there is no statistically significant relationship between differences in school quality and differences in mortality, though the coefficient is in the expected direction.

To examine the robustness of these relationships, Table 3 repeats the results from equation (2) in the first column and the second column restricts the sample to exclude individuals born between 1910 and 1929 in states with high hookworm rates to examine whether these results are driven by the public health improvements resulting from the near eradication of hookworm. The third column in these tables restricts the sample to exclude the 1910 cohort to examine the potential influence of selective mortality. As shown in these columns, the relationship between school quality and disability status is robust for these restricted samples and specifications. The relationships between school quality and self-rated health are robust to excluding the 1910 cohort, but the magnitudes diminish once we exclude individuals born in states with high hookworm rates.

In Table 4, we examine whether these results are mediated by family income or emigration from the South. For most outcomes, including black-white differences in current income as measured in the NHIS attenuates the coefficients on the black-white school quality differences. However, a statistically significant relationship between school quality and disability status remains. These results suggest that income does play an important mediating role but does not completely explain the relationship between difference in school quality and disability status. Including black-white differences in the percent of individuals who currently reside in the South shows that migration influences the estimates of the relationship between school quality and health in the opposite direction of income. These results suggest that black-

white differences in school quality had a stronger impact on health differences among individuals who did not emigrate from the South. For example, the magnitudes for self-rated health and disability status increase in absolute value and the estimate for mortality nearly doubles and becomes statistically significant, which is consistent with the negative impact of migration to the North on mortality among southern blacks (Black et al., 2011).

6. Conclusion

In this paper, we present one of the first investigations of the effect of school quality on long-run racial differences in health. As racial differences in health have been a recalcitrant policy issue in the U.S., it is important to understand how different social policy changes may affect health differences. Although there have been major changes in racial patterns of school quality in the U.S., the effect of school quality on racial health differences has rarely been studied. Using within-state and over time variation in school quality from segregated southern states, we find that convergence in school quality between blacks and whites led to statistically significant, though modest, long-run effects of reducing racial gaps in disability, with some evidence of a reduction in self-rated health. For example, the black-white gap in percent with any disability for 60-64 year olds grew from 0.059 in 1984-1987 to 0.091 in 2004-2007. The analogous black-white gap in the school quality index measure dropped from 1.56 in 1984-1987 to 0.38 in 2004-2007. Based on our regression results, the disability gap would have grown to 0.114 in 2004 if the average gap in the school quality index had stayed constant at the levels of the 1984-1987 cohorts.

One potential limitation of our analysis is that public health initiatives or other unobserved changes in family or individual characteristics could bias our results. For this to

occur, these changes would have to mirror the changes within-states and over time in the racial convergence in school quality, and be correlated with health later in life. To minimize this potential source of bias, we control for racial differences in the infant mortality rate and socioeconomic status. We also examine the robustness of our results to excluding states with high hookworm rates that were most affected by the hookworm eradication campaign in the early 1900s. Our results suggest that the potential influences on our estimates for disability status from these concerns are likely to be minimal.

Another potential limitation of our analyses is the possibility that our results are biased by selective mortality. For the older cohorts in our sample, if racial differences in school quality led to differential mortality between blacks and whites, then we would expect that our results may actually understate the effects of school quality on racial differences in health. This direction of bias would emerge because we do not observe effects of racial differences in school quality among those who died prior to being interviewed in the NHIS, and because the black survivors represented in the cells may be in relatively better health than the white survivors. However, we also expect that our use of weights based on cell size will minimize this latter source of bias since the cells which experienced significant attrition prior to the NHIS are relatively less populated and thus receive relatively smaller weights in our analyses. Additionally, our results that show a small and statistically insignificant relationship between racial differences in school quality and mortality, as well as the robustness of our results to excluding the eldest cohort, suggests that any bias from selective mortality is likely to be minimal.

Our results imply that improving school quality for blacks relative to whites may lead to some modest reductions in black-white health differences later in life. Even though on average racial differences in school quality have dropped significantly from the period that we study,

there is still room for improvement in the context of current school quality. For example, Clotfelter, Ladd, and Vigdor (2005) find that black students were more likely than whites to be in school districts with less-experienced teachers, and within districts are more likely than whites to attend schools with less-experienced teachers. Although the magnitude of our results are relatively modest, they are still of importance given that in spite of considerable policy attention to reducing black-white differences in health, these disparities have not shown much change.

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Table 1: Summary Statistics of School Quality and Health Measures for Blacks and Whites

	Blacks		Whites		Black - White	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
School Quality Index	-0.251	(1.061)	0.315	(0.490)	-0.566	(0.726)
Pupil-Teacher Ratio	33.935	(6.925)	28.774	(2.805)	5.161	(5.509)
Teachers' Wages (000s)	2.828	(1.484)	3.315	(1.183)	-0.487	(0.459)
Term Length	166.068	(17.380)	172.579	(7.754)	-6.510	(12.377)
Mortality	0.268	(0.198)	0.219	(0.196)	0.049	(0.065)
Self-Reported Health	2.972	(0.285)	2.603	(0.318)	0.369	(0.197)
Excellent or Very Good Self-Reported Health	0.338	(0.097)	0.480	(0.117)	-0.142	(0.080)
Fair or Poor Self-Reported Health	0.339	(0.104)	0.229	(0.090)	0.109	(0.069)
Any Limitations	0.336	(0.118)	0.273	(0.102)	0.063	(0.070)
Body Mass Index	27.969	(1.276)	26.151	(1.066)	1.818	(1.664)
Underweight	0.013	(0.015)	0.021	(0.018)	-0.008	(0.020)
Overweight	0.690	(0.083)	0.554	(0.125)	0.136	(0.1410)
Obese	0.295	(0.102)	0.183	(0.058)	0.113	(0.102)
Morbidly Obesity	0.102	(0.062)	0.049	(0.024)	0.053	(0.056)
Ever Smoked	0.575	(0.163)	0.580	(0.148)	-0.005	(0.098)
Currently Smoke	0.312	(0.140)	0.261	(0.097)	0.051	(0.099)
Infant Mortality Rate	70.571	(25.122)	44.702	(15.305)	25.869	(12.333)
Family Size	4.636	(0.694)	4.393	(0.299)	0.243	(0.631)
Duncan SEI Occupational Earnings Score	331.369	(35.417)	422.337	(26.625)	-90.968	(40.701)
Income	27667.92	(9529.74)	38555.12	(11427.65)	-10887.19	(4446.76)
Reside in the South	0.618	(0.217)	0.799	(0.157)	-0.181	(0.157)
Number of Observations	462		462		462	

Notes: This table displays the means, with the standard deviations in parentheses, for blacks, whites, and the mean for blacks minus the mean for whites in health and school quality for individuals born in the 18 southern states between 1910 and 1950.
Sources: National Health Interview Survey 1984-2007; Card and Krueger (1992).

Table 2: The Influence of Black – White Differences in School Quality on Black – White Differences in Health

	Equation (1)	Equation (2)
Panel A: Self-Rated Health		
Black – White School Quality	-0.0710	-0.0715*
	(0.0414)	(0.0375)
R-squared	0.210	0.237
Panel B: Excellent/Very Good Self-Rated Health		
Black – White School Quality	0.0214	0.0249*
	(0.0146)	(0.0141)
R-squared	0.255	0.273
Panel C: Fair/Poor Self-Rated Health		
Black – White School Quality	-0.0211	-0.0241*
	(0.0130)	(0.0115)
R-squared	0.117	0.142
Panel D: Body Mass Index		
Black – White School Quality	-0.151**	-0.0463
	(0.0680)	(0.110)
R-squared	0.769	0.780
Panel E: Obesity		
Black – White School Quality	-0.00985**	-0.00611
	(0.00431)	(0.00710)
R-squared	0.556	0.565
Panel F: Ever Smoked		
Black – White School Quality	0.0328**	0.00507
	(0.0125)	(0.0140)
R-squared	0.065	0.115
Panel G: Currently Smoke		
Black – White School Quality	0.0138	-0.00714
	(0.0153)	(0.0140)
R-squared	0.172	0.196
Panel H: Any Limitations		
Black – White School Quality	-0.0203**	-0.0249**
	(0.00815)	(0.00878)
R-squared	0.141	0.146
Panel I: Mortality		
Black – White School Quality	-0.00163	-0.00606
	(0.00541)	(0.00603)
R-squared	0.167	0.174
Observations	462	462

Notes: Heteroskedasticity-robust standard errors that allow for clustering within state of birth are in parentheses. Each coefficient estimate is based on a separate regression. Additional covariates in equation (1) that are not shown include the black/white difference in infant mortality rate, cohort fixed effects, and survey year fixed effects. Equation (2) also includes the black/white difference in average family size and the average Duncan SEI occupational earnings score.

Sources: National Health Interview Survey 1984-2007; Card and Krueger (1992).

*** p<0.01, ** p<0.05, * p<0.1

Table 3: The Robustness of Estimates of the Influence of Black – White Differences in School Quality on Black – White Differences in Health

	Equation (2)	Excluding States with High Hookworm Rates	Excluding the 1910 Cohort
Panel A: Self-Rated Health			
Black – White School Quality	-0.0715*	-0.0491	-0.0773
	(0.0375)	(0.0405)	(0.0484)
R-squared	0.237	0.228	0.209
Panel B: Excellent/Very Good Self-Rated Health			
Black – White School Quality	0.0249*	0.0171	0.0275
	(0.0141)	(0.0148)	(0.0179)
R-squared	0.273	0.254	0.228
Panel C: Fair/Poor Self-Rated Health			
Black – White School Quality	-0.0241*	-0.0192	-0.0278*
	(0.0115)	(0.0123)	(0.0143)
R-squared	0.142	0.126	0.135
Panel D: Body Mass Index			
Black – White School Quality	-0.0463	0.0187	-0.0678
	(0.110)	(0.132)	(0.144)
R-squared	0.780	0.778	0.791
Panel E: Obesity			
Black – White School Quality	-0.00611	-0.00472	-0.00716
	(0.00710)	(0.00930)	(0.00886)
R-squared	0.565	0.556	0.580
Panel F: Ever Smoked			
Black – White School Quality	0.00507	0.0115	0.00303
	(0.0140)	(0.0156)	(0.0180)
R-squared	0.115	0.099	0.104
Panel G: Currently Smoke			
Black – White School Quality	-0.00714	-0.00210	-0.0117
	(0.0140)	(0.0154)	(0.0153)
R-squared	0.196	0.182	0.188
Panel H: Any Limitations			
Black – White School Quality	-0.0249**	-0.0237**	-0.0232*
	(0.00878)	(0.0107)	(0.0121)
R-squared	0.146	0.138	0.134
Panel I: Mortality			
Black – White School Quality	-0.00606	-0.00398	-0.00420
	(0.00603)	(0.00842)	(0.00666)
R-squared	0.174	0.157	0.119
Observations	462	392	406

Notes: Heteroskedasticity-robust standard errors that allow for clustering within state of birth are in parentheses. Each coefficient estimate is based on a separate regression. Additional covariates that are not shown include black/white differences in infant mortality rate, average family size, and the average Duncan SEI occupational earnings score; cohort fixed effects; and survey year fixed effects.
Sources: National Health Interview Survey 1984-2007; Card and Krueger (1992).
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Potential Mechanisms through which Black – White Differences in School Quality Influence Black – White Differences in Health

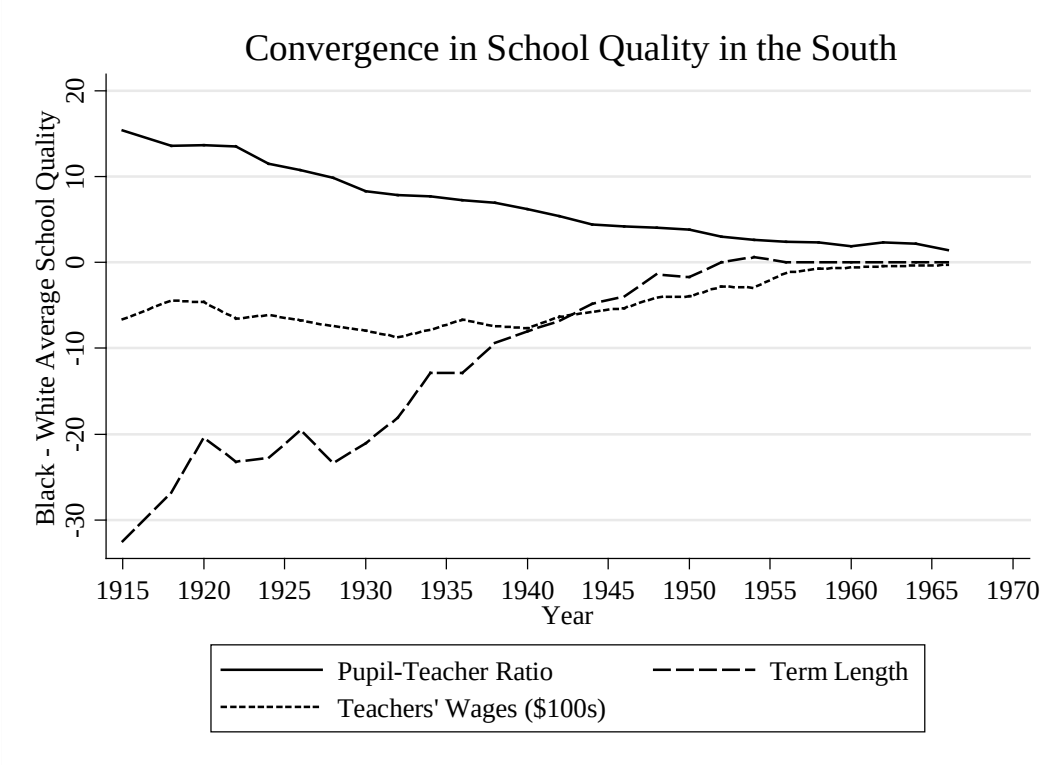
	Equation (2)	Family Income	Migration to the North
Panel A: Self-Rated Health			
Black – White School Quality	-0.0715*	-0.0406	-0.105***
	(0.0375)	(0.0310)	(0.0320)
R-squared	0.237	0.379	0.287
Panel B: Excellent/Very Good Self-Rated Health			
Black – White School Quality	0.0249*	0.0150	0.0379***
	(0.0141)	(0.0120)	(0.0112)
R-squared	0.273	0.360	0.319
Panel C: Fair/Poor Self-Rated Health			
Black – White School Quality	-0.0241*	-0.0138	-0.0303**
	(0.0115)	(0.00932)	(0.0121)
R-squared	0.142	0.266	0.156
Panel D: Body Mass Index			
Black – White School Quality	-0.0463	-0.0215	-0.00798
	(0.110)	(0.116)	(0.0915)
R-squared	0.780	0.781	0.781
Panel E: Obesity			
Black – White School Quality	-0.00611	-0.00291	-0.00508
	(0.00710)	(0.00767)	(0.00599)
R-squared	0.565	0.571	0.566
Panel F: Ever Smoked			
Black – White School Quality	0.00507	0.00831	0.000103
	(0.0140)	(0.0131)	(0.0128)
R-squared	0.115	0.121	0.119
Panel G: Currently Smoke			
Black – White School Quality	-0.00714	-0.00142	-0.00933
	(0.0140)	(0.0127)	(0.0146)
R-squared	0.196	0.215	0.197
Panel H: Any Limitations			
Black – White School Quality	-0.0249**	-0.0189**	-0.0276***
	(0.00878)	(0.00862)	(0.00694)
R-squared	0.146	0.189	0.149
Panel I: Mortality			
Black – White School Quality	-0.00606	-0.00272	-0.0112*
	(0.00603)	(0.00624)	(0.00579)
R-squared	0.174	0.189	0.185
Observations	462	462	462

Notes: Heteroskedasticity-robust standard errors that allow for clustering within state of birth are in parentheses. Each coefficient estimate is based on a separate regression. Additional covariates that are not shown include black/white differences in infant mortality rate, average family size, and the average Duncan SEI occupational earnings score; cohort fixed effects; and survey year fixed effects.

Sources: National Health Interview Survey 1984-2007; Card and Krueger (1992).

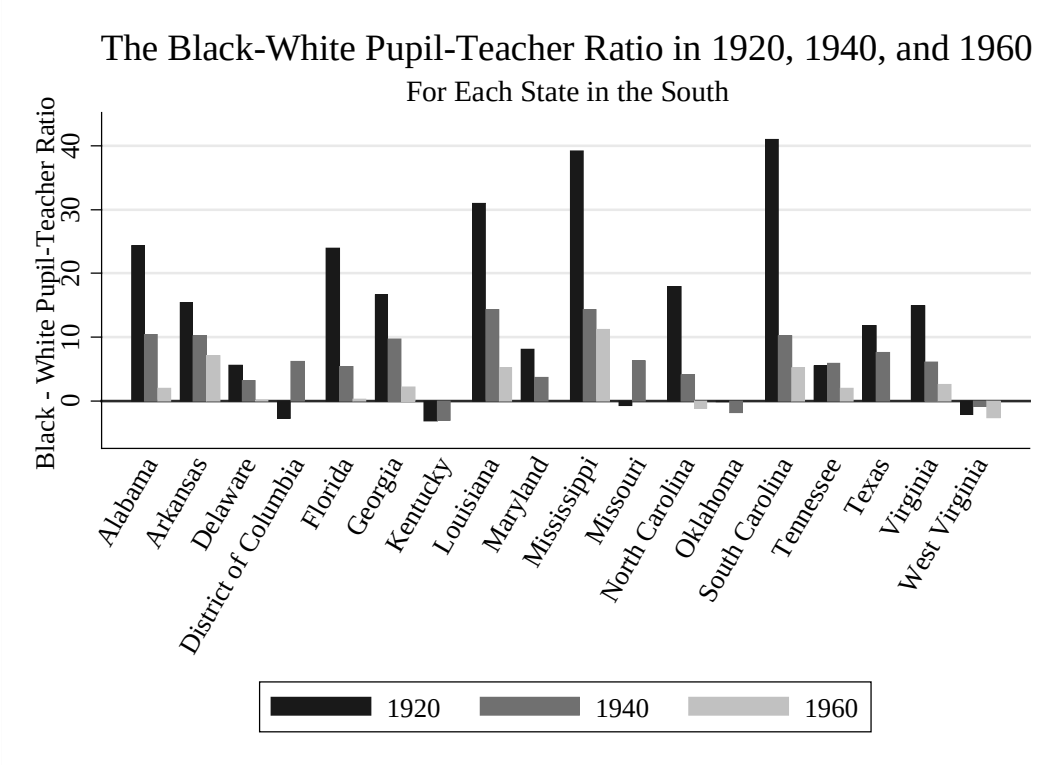
*** p<0.01, ** p<0.05, * p<0.1

Figure 1



Source: Card and Krueger (1992).

Figure 2



Source: Card and Krueger (1992).

Appendix Table 1: The Influence of Black – White Differences in School Quality on Black – White Differences in Health Measures

	Self-Rated Health	Excellent/ Very Good Self-Rated Health	Fair/Poor Self-Rated Health	Body Mass Index	Obesity	Ever Smoked	Currently Smoked	Any Limitations	Mortality
Pupil-Teacher Ratio	0.00817	-0.00335	0.00236	0.0104	0.000861	-0.00124	0.000676	0.00293**	0.000859
	(0.00624)	(0.00225)	(0.00200)	(0.0154)	(0.00106)	(0.00203)	(0.00182)	(0.00138)	(0.000855)
Observations	462	462	462	462	462	462	462	462	462
R-squared	0.231	0.275	0.131	0.780	0.565	0.116	0.196	0.142	0.174
Teachers' Wages	-5.53e-05	1.71e-05	-2.15e-05	4.08e-05	-7.35e-07	-1.48e-05	-4.07e-05**	-2.12e-05	-2.06e-06
	(7.07e-05)	(2.77e-05)	(1.77e-05)	(0.000174)	(1.04e-05)	(1.89e-05)	(1.59e-05)	(1.44e-05)	(7.46e-06)
Observations	462	462	462	462	462	462	462	462	462
R-squared	0.216	0.257	0.125	0.780	0.565	0.116	0.209	0.128	0.172
Term Length	-0.00372**	0.00109	-0.00138**	-0.000956	-0.000293	8.51e-05	-0.00031	-0.00132***	-0.000282
	(0.00165)	(0.000635)	(0.000543)	(0.00499)	(0.000325)	(0.000624)	(0.0007)	(0.000438)	(0.000305)
Observations	462	462	462	462	462	462	462	462	462
R-squared	0.234	0.266	0.144	0.779	0.565	0.114	0.196	0.145	0.173

Notes: Heteroskedasticity-robust standard errors that allow for clustering within state of birth are in parentheses. Each coefficient estimate is based on a separate regression. Additional covariates that are not shown include the black/white differences in the infant mortality rate, average family size, and the average Duncan SEI occupational earnings score; cohort fixed effects; and survey year fixed effects.

Sources: National Health Interview Survey 1984-2007; Card and Krueger (1992).

*** p<0.01, ** p<0.05, * p<0.1