Secondary School Segregation and the Transition to College

Introduction

Nearly 60 years after racial school segregation was deemed unconstitutional, it continues to pervade American education. Research documents negative consequences of school segregation on academic achievement and lasting impacts on educational attainment and occupational outcomes (Wells & Crain, 1994; Mickelson 2008; Mickelson & Nkomo, 2012). However, most studies measure exposure to racially segregated schools (black- or minority-concentrated) at one point in time. This characterization unrealistically simplifies student experiences and ignores changing policy and demographic contexts. Major changes in educational policy over the last several decades include increasing school choice, eliminating race as a factor in admissions decisions, and the rollback of court-ordered desegregation plans. In addition, the country has seen rapid demographic changes, including a rising proportion of minority students and increasing minority movement to the suburbs (Frankenberg et al., 2003; Reardon & Yun, 2001; Frankenberg & Orfield, 2012). These changes, in addition to student school mobility, suggest that over the course of their educational careers students may be exposed to schools with varying racial compositions. Studies using snapshot measures cannot account for changes in segregation exposure and, as a result, may describe just a fraction of students' school contexts. Furthermore, these studies fail to capture important temporal dimensions of exposure, including whether the highest levels of segregation are experienced in earlier or later grades, whether exposure is stable or changing over time, and the total length of time exposed. There exists on insufficient evidence on long-term student exposure to school segregation. More importantly, we do not understand the consequences of variation in the timing, sequencing, and duration of segregation exposure on college outcomes. At a time when college is critical for economic mobility and when minority students continue to lag behind in college enrollment and completion (Fry, 2011), evidence on these issues is critical for educational policy.

The primary objective of this study is to determine the effect of differences in the timing, sequencing, and duration of exposure to black school segregation on postsecondary educational outcomes. For this analysis, I employ a method of causal inference—marginal structural models—that accounts for dynamic selection into schools, allows for time-varying treatment (exposure to school segregation), and addresses time-varying confounding (Robins, Hernan, Brumback 2000). The study extends our understanding of the consequences of school segregation by dealing with confounding in order to estimate the causal effect of important temporal dimensions of exposure.

Theoretical Considerations

The study is guided by the life-course perspective which emphasizes the need to follow individuals over time in order to link experiences in childhood and adolescence with outcomes in adulthood (Elder, 1999; 1985; 1998). I argue that temporal dimensions of school segregation exposure in middle and high school—timing, sequencing, and duration—are important factors that not only differentiate the educational experiences of groups of students but also affect college outcomes. Previous studies find that attending predominantly black or minority schools negatively affects educational achievement and attainment (Wells & Crain, 1994; Mickelson, 2008; Mickelson & Nkomo, 2012). However, measuring exposure over time may reveal larger effects or effects that differ across temporal dimensions.

There are two plausible hypotheses with respect to how *timing* of exposure may matter for college outcomes. Because black concentrated schools generally have fewer resources—including challenging curriculum and highly qualified teachers (Goldsmith, 2003; Hanushek & Rivkin, 2009)—early exposure may set students on a lower achieving and course-taking trajectory (Lucas, 1999). Alternatively, exposure to black segregation in later grades may be most harmful for college enrollment because access to academically-oriented peer climates and extracurricular resources such as guidance counselors may be essential for successfully transitioning from high school to college (McDonough, 1997). Longer *duration* represents more exposure to the disadvantages of black segregated schools, including negative peer climates and lower teacher expectations (Orfield & Eaton, 1996). These disadvantages have been shown to negatively influence educational outcomes using cross-sectional measures of exposure (Rumberger & Palardy, 2005); therefore, longer durations of exposure will likely lead to worse college outcomes as some research on cumulative exposure to disadvantage in non-school environments suggests (Duncan, Brooks-Gunn, Klebanov, 1994; Wheaton & Clarke, 2003; Wodtke et al., 2011). In terms of *sequencing*, moving *into* more segregated schools will likely diminish the probability of college success while moving *out of* highly black segregated schools will improve outcomes because of the disadvantages and advantages associate with each condition.[1] However, changing exposure may be most detrimental due to inconsistencies in teaching, curriculum, and peer environments.

Data

The project will use data from the National Longitudinal Survey of Youth 1997 (NLSY97) merged with school data from the National Center for Education Statistics' Common Core of Data (CCD) and Private School Survey (PSS). The NLSY97, administered by the U.S. Bureau of Labor Statistics, follows a nationally representative sample of 8,894 students who were 12 to 16 years old on December 31, 1996. There are currently 14 waves of annual data available. The CCD and PSS are annual and biannual surveys that provide demographic data (including racial composition) on the universe of public and private schools, respectively. This study creates a unique merged dataset that links school data from CCD and PSS to the student-level data in NLSY97 using the school identification variables available on the restricted-use data files at the Bureau of Labor Statistics. The NLSY97 is ideally suited to answering this study's research questions primarily because it contains information on every school ever attended by respondents starting in 7th grade. No other national studies record such a complete schooling history. The NLSY97 also contains rich longitudinal background information on adolescents and their families which allows me to use quasi-experimental methods that reduce selection bias and, under the assumption of no unobserved confounding, produce causal estimates. Finally, respondents have been followed through 2010 (25 to 29 years old) allowing sufficient time for the majority of degree recipients to graduate from college (NCES, 2011).

The analytic sample is limited to respondents who had not yet completed 8th grade as of the first interview, who were observed over the entire period of interest, and who resided in a

[1] Some caution is warranted here because whether or not students benefit from moving into better-resourced schools may depend on whether they are able to enroll in the higher-level courses and be taught by the better-qualified teachers, which may be dependent on the student's race. Previous research finds that minority students are at a disadvantage in accessing resources even if they are in schools that contain them (Crosnoe, 2009; Tyson, 2011; Goldsmith, 2011). I will examine effects by race to explore this possibility.

metropolitan area of the country at baseline with at least 6% black residents.[2] These restrictions reduce the sample size to approximately 2,700 students, but allow for complete data on important time-varying covariates necessary for obtaining causal estimates.

Measures. The two *outcomes* are college enrollment and college completion. Enrollment is a necessary first step, but college completion predicts economic advantages throughout one's career (Card, 1999). *Treatment* is defined as the student's exposure to black school segregation at each wave from 8th to 12th grade. I include a wide range of potentially confounding covariates in order to isolate the causal effect of segregation exposure on college outcomes. Time-constant covariates include student gender, race/ethnicity, immigrant status, and maternal education. Time-varying covariates include family variables (poverty status, family structure) and student characteristics (school mobility, academic course-taking, problem behaviors). Missing data on covariates will be imputed using multiple imputation (Allison, 2001).

Analytic Strategy

I will use a counterfactual framework to estimate the causal effect of exposure to black school segregation on college outcomes using marginal structural models (MSMs) (Robins et al., 2000; Robins, 1999). Borrowing notation from Robins et al. (2000), I let A_k be the treatment (attendance at school that is 90-100% black) at the k[th] follow-up (k=1, 2, 3, 4, 5 for 5 waves of data). Then let $\bar{a} = \bar{a}_K$ represent a student's history of segregation exposure $(a_1, a_2, a_3, a_4, a_5)$. Let Y be the observed outcome of interest, either college enrollment or college completion. I am interested in estimating $Y_{\bar{a}}$, or the potential outcome indicating whether a student enrolled (or completed) college given experiencing the segregation history $\bar{a}$. Each student has only one observed $Y_{\bar{a}}$; all others (i.e., $Y_{\bar{a}'}$) are unobserved or counterfactual. The estimate of the average causal effect of one exposure history compared to another exposure history is $E(Y_{\bar{a}} - Y_{\bar{a}'}) = P(Y_{\bar{a}} = 1) - P(Y_{\bar{a}'} = 1)$, where $P(Y_{\bar{a}} = 1)$is the probability of enrolling in (or completing) college if all students experienced exposure history $\bar{a}$, and similar for $\bar{a}'$.

The presence of time-varying treatment (segregation exposure during middle and high school) and time-varying covariates render standard methods for estimating exposure effects, including regression adjustment, biased (Robins et al., 2000). Using inverse probability-of-treatment weighting (IPTW), MSMs eliminate bias between treatment and outcome by fitting a model that weights each respondent at each wave by the inverse predicted probability that he received his own observed treatment given prior treatment, time-varying covariate history, and time-invariant covariates (Robins et al., 2000; Robins, 1999).

There are two major steps to estimate the effect of black school segregation on college enrollment and completion using MSMs. *First, I predict treatment exposure (attending a school that is 90-100% black) for every individual at each time point in order to calculate the inverse probability of treatment weights (IPTW).* Using a logistic regression model, I estimate each student's probability of receiving his own treatment at each wave. The model is a function of time-constant covariates, treatment status at *k-1*, and time-varying covariates at waves *k* and *k-1*:

$$logit(P(a_k = 1)) = \alpha_j + \beta_1 L_0 + \beta_2 A_{k-1} + \beta_3 L_{k,k-1}$$

where $a_k$is whether the student's school was 90-100% black at wave *k*, L_0 is a set of time-constant background characteristics, A_{k-1} is the treatment level at wave *k-1*, and $L_{k,k-1}$ is a set

[2] This restriction is placed on the analytic sample in order to ensure that there is a non-zero probability that respondents attend school with black students. Six percent represents approximately half of the national average percentage of black residents in 2000.

of time-varying covariates from waves *k* and *k-1*.[3] Results from the logistic regression will be used to create stabilized IPT weights (sw_i) for each student in the sample. The weight for the *i*th student at the *k*th wave is

$$sw_i = \prod_{k=1}^{K} \frac{P(A_k = a_{ki} | \bar{A}_{k-1} = \bar{a}_{(k-1)i}, \bar{L}_0 = \bar{l}_0)}{P(A_k = a_{ki} | \bar{A}_{k-1} = \bar{a}_{(k-1)i}, \bar{L}_k = \bar{l}_{ki})}$$

I will also create censoring weights (cw_i) which help correct for nonrandom sample attrition over the 14 waves of the study. These are created by modeling the different probabilities individuals have of "surviving" all 14 waves (Robins et al. 2000) in a logistic regression.

In the second step, I will model the outcome using the calculated weights. Final estimates for the probability of enrolling in or completing college are then based on logistic regression models using the final for every individual in the sample ($final\ weight = cw_i$ x sw_i). I will estimate the effect of exposure to black school segregation on the probability of two outcomes (college enrollment and college completion) using the following model:

$$logit\ Pr[Y_{\bar{a}} = 1] = \beta_0 + \beta_1 a_1 + \beta_2 a_2 + \beta_3 a_3 + \beta_4 a_4 + \beta_5 a_5$$

where $Pr[Y_{\bar{a}} = 1]$ is the probability of college enrollment or completion given trajectory $\bar{a}$ and is a function of exposure to black school segregation. That is, the probability of college enrollment or completion depends on $\bar{a}$ through indicator variables corresponding to the treatment combination involved in $\bar{a}$. The intercept β_0 estimates the probability of the outcome if all students experienced no segregation exposure. The sum $\beta_0 + \beta_1 + \beta_2 + \beta_3 + \beta_4 + \beta_5$ estimates the probability of the outcome if all students experienced exposure to black school segregation throughout middle and high school. Each β_k coefficient can be interpreted as the change in log odds of enrolling in or completing college if all students were exposed to a black segregated school at wave *k* relative to the reference group of all students not being exposed to a segregated school, holding exposure level at all other time points constant.

I will first estimate weights and MSMs for the entire population. I will then estimate weights and MSMs separately by race (e.g., whites only, blacks only) in order to estimate group-specific treatment effects.

Expected Findings

Analyses are ongoing and estimates are subject to review by project officers at the Bureau of Labor Statistics prior to release. However, I expect that exposure to black school segregation will have a *negative* effect on college enrollment and college completion. I expect early exposure will be *more detrimental* than later exposure because of the lasting effects of early disadvantage on later academic course-work. I predict that longer periods of exposure will lead to *lower likelihood* of college enrollment and completion. Changing exposure will be *more negative* than stable exposure or non-exposure due to inconsistent expectations, curriculum, and resources.

[3] I will try a variety of model specifications in order to choose the best weights based on bias and variance (Cole and Hernan, 2008). In general, I want to find a mean weight that is close to 1, to include a large number of covariates (confounders) to reduce bias in the estimated effect, and to have a small spread of weights to reduce the variance in my estimated effect (*ibid.*). I will also explore the possibility of truncating weights, such as at the 1st and 99th percentile (*ibid.*).

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