

New Evidence about *Brown v. Board of Education*: The Complex Effects of School Racial Composition on Achievement

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Abstract

Uncovering the effects of school racial composition on achievement is difficult, because racial mixing in the schools is not an accident but instead represents a complex mixture of government and family choices. While the goals of the integration of schools legally inspired by *Brown v. Board of Education* are very broad, here we focus more narrowly on how school racial composition affects scholastic achievement. Our evaluation, made possible by rich panel data on the achievement of Texas students, disentangles racial composition effects from other aspects of school quality and from differences in student abilities and family background. The results show that a higher percentage of Black schoolmates has a strong adverse effect on achievement of Blacks and, moreover, that the effects are highly concentrated in the upper half of the ability distribution. In contrast, racial composition has a noticeably smaller effect on achievement of lower ability blacks and whites – strongly suggesting that the results are not a simple reflection of unmeasured school quality.

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School integration is one of the most explosive policy issues of the past fifty years, and the political debate and conflict has touched most areas of the country. Much of the early public discussion centered on the proper role of racial desegregation and the best methods for accomplishing its purposes, but, despite a lack of policy consensus, substantial changes occurred in enrollment patterns in U.S. public schools. Nonetheless, close to five decades after the landmark school desegregation case of *Brown v. Board of Education*, a surprising amount of uncertainty still exists about the ultimate effects of school desegregation on academic, social, and labor market outcomes for both minority and white students. This study pursues a new approach for isolating the effects of school racial composition on achievement and provides estimates of its importance for the State of Texas. The resulting analysis provides new insights into the role of peers in affecting school outcomes.

The ruling in *Brown v. Board of Education* (1954) held that separate but equal, while not inherently unconstitutional in all areas, was unconstitutional in the case of education because separate could not be equal.¹ This ruling led to dramatic changes in schools throughout the country, and this history of changes in enrollment patterns both for the nation and for Texas provides an important backdrop for the current study. These changes did not take place overnight, and, even 15 years after the initial court ruling, schools remained largely segregated. The decade of the 1970s, however, witnessed a substantial reduction in segregation brought about largely through legal pressure on local school districts (Welch and Light (1987)). But the countervailing trend of the large-scale exodus of whites from many cities and towns clearly dampened the impact of school desegregation on interracial contact.

¹ *Brown v. Board of Education*, 347 U.S. 483 (1954).

Texas schools are interesting as an example of the changes that have occurred in many previously segregated systems. They experienced the dual pressures of court-ordered desegregation decrees and dramatic demographic shifts resulting from suburbanization, immigration, and rapid overall population growth. The combination of these and other forces leaves today's black public school students in Texas likely to have far more white schoolmates than did their parents or grandparents in the late 1960s.

Despite reductions in segregation and other aspects of school inequality, black students in Texas have achievement noticeably below white students, mirroring that for the nation as a whole. For example, the average mathematics score for black seventh graders is 0.7 standard deviations below that of whites.² Further, only 29 percent of blacks score in the top half of the state distribution.

This paper investigates the contribution of school racial composition to the racial and ethnic achievement gap. It makes use of a unique matched panel data set on individual students and schools to identify the impacts of racial composition on academic achievement and to differentiate these from other aspects of school quality that might drive any observed relationship between achievement and school demographic composition. While controls for observable family and school characteristics are used, it is the ability to control for an array of fixed effects that permits the clearest identification of the effect of racial composition. Ultimately, we identify these effects by differences in the pattern of racial composition for successive cohorts of students in a given school as they age.

Our basic estimation of elementary school achievement growth finds that achievement for black students is negatively related to the black enrollment share. But the detailed analysis provides a more complex picture – the adverse effects of racial composition are concentrated on higher ability blacks. In contrast, racial and ethnic composition has considerably less influence

on the achievement gains of whites or Hispanics, indicating that racial composition is not simply serving as a proxy for general school or teacher quality. This peer effect for blacks is also not driven by racial differences in average achievement or SES. Nor is it a minority effect, because concentrations of other minority groups, notably Hispanics, do not significantly affect black students.

This analysis is limited to investigation of pure racial composition effects and does not investigate other differences in school quality that might be correlated with race. For a variety of reasons, we suspect that other school disadvantages also increase with more racial concentration, and these would be additive to the peer influences uncovered here.

School and District Enrollment Patterns

The evolution of school enrollment patterns provides important information on the determinants of school racial composition and the potential biases that must be addressed in trying to isolate the causal effect of school racial composition on achievement. Racial separation in public schools today is primarily attributable to residential segregation across jurisdictions and to the large concentrations of Hispanics in areas bordering Mexico and New Mexico. Rivkin (1994) shows that in 1988, even if all U.S. school districts had been perfectly integrated (each school having the district share of all demographic groups), housing patterns would have led to a schooling system in which large numbers of blacks would have few white schoolmates. The time pattern of integration of Texas public schools is quite similar to those of all southern states grouped together as well as the U.S. as a whole, but, as described below, the distribution of black students by percent black in their schools is more even than in many other southern and northern states.

² The comparable black-white mathematics score gap for students age 13 in 1996 for the nation is 0.9 standard deviations (U.S. Department of Education (2000)). The gap in Texas state NAEP scores is, however, less than that for the nation (U.S. Department of Education (1997)).

Table 1 shows the demographic composition of Texas public schools.³ Between 1968 and 1998 the relative decline in white enrollment was roughly offset by increases in Hispanic enrollment, while the black enrollment share declined only slightly. White enrollment fell from 64 percent to 45 percent of the total during the thirty-year period, while Hispanic enrollment increased from 19 percent in 1968 to 38 percent in 1998.⁴ In sum, Texas public schools experienced substantial changes in demographic composition. Despite the dramatic shifts in public school demographic composition, the rate of attendance at private schools in Texas is below that for the nation – 6 versus 11 percent in 1997 – and was virtually unchanged between 1980 and 1997. Thus it accounted for little of the changes experienced by the public schools.

Even with the pronounced decline in the overall share of white enrollment, the average percentage of blacks' schoolmates who were white (exposure index) increased by roughly 50 percent between 1968 and 1980, rising from 24 to 35 percent (Table 2). This increase was driven primarily by the expansion of school desegregation efforts across the state. Since 1980, however, exposure has fallen, reflecting the decline in the white share of enrollment and lack of new desegregation programs. The rise in exposure during the 1980s and subsequent decline is similar to the pattern observed for the United States as a whole.

The reduction of segregation that led to increased exposure during the 1980s is captured quite well by the school dissimilarity index (second row of Table 2), measured as the percentage

³ The Texas data on students (discussed below) along with data from the Office of Civil Rights (OCR) Bi-Annual Survey of Public Schools for 1968, 1980, and 1992 are used in the description of school and district enrollment patterns. Adding the OCR data permits us to document enrollment patterns over the thirty-year period from 1968 to 1998. The data provide school enrollment counts for American Indians, Asians, blacks, Hispanics, and whites as well as weights that can be used to produce projections for the state as a whole. The OCR data contain a sample of districts for each state. Sixty-five Texas districts are sampled in all surveys, and we compute separate enrollment statistics for each of these districts. Our analysis eliminates one sampled district that was reconstituted over the time period. Importantly, because the OCR surveys only a portion of the public schools in Texas, the data must be weighted by the inverse probability of selection into the sample to generate statewide projections. Not surprisingly the different samples (OCR and Texas administrative data) produce slightly different segregation and enrollment statistics for 1992, the year the two data sets overlap. However, the aggregate differences are minor (as shown below), and the statistics for the individual school districts are virtually identical.

Table 1. Racial Composition of Texas Schools, 1968-98

	1968 ^a	1980 ^a	1992 ^a	1992 ^b	1998 ^b
Percentage Black	16.1	14.4	15.2	14.3	14.4
Percentage Hispanic	19.3	30.4	29.7	34.5	37.9
Percentage White	64.3	54.1	52.7	48.8	45.0
Enrollment	2,662,720	2,846,106	3,504,860	3,464,371	3,897,641

Notes: a. Weighted calculations using data from the Bi-Annual Survey of Public Schools of Office of Civil Rights (OCR) of the Department of Education for 65 sampled districts from Texas that appear in the 1968, 1980, and 1992 surveys.

b. Calculations using data from PEIMS (Public Education Information Management System) of the State of Texas.

Table 2. Black-White Exposure and Dissimilarity Indexes, 1968-98

	1968 ^a	1980 ^a	1992 ^a	1992 ^b	1998 ^b
Exposure Index (%)^c	24.4	35.2	33.0	34.6	30.9
Dissimilarity Index (%)^d					
Across schools	74.2	61.1	59.6	57.5	59.1
Across districts	44.3	54.7	53.3	51.7	52.3

Notes: a. Weighted calculations using data from the Bi-Annual Survey of Public Schools of Office of Civil Rights (OCR) of the Department of Education.

b. Calculations using data from PEIMS (Public Education Information Management System) of the State of Texas.

c. Percentage white schoolmates for the average black student.

d. Percentage of black students who would have to change schools (districts) to have a uniform distribution of black students across schools (districts).

of whites (or blacks) who would have to change schools in order for the white and black enrollment shares to be identical in all schools. It ranges from 0 (complete integration) to 100 (complete segregation). The Texas index declines from 74 percent in 1968 to 61 percent in 1980, but remains roughly constant thereafter. Thus, while there was a substantial reduction in segregation during the 1970s, there was little additional progress in the 1980s and 1990s.⁵

Importantly, school segregation is determined by both the distribution of families among districts (residential choices) and district attendance patterns.⁶ The degree to which ethnic groups concentrate in different regions and districts limits the extent to which school district policies can reduce overall school segregation. Comparisons of residential segregation by district (third row of Table 2) and school segregation reveal a convergence over time, indicating that the current distribution of school racial composition cannot be altered much without moving students across district lines – a policy that is difficult to justify legally and something only rarely contemplated in judicial or legislative actions.

Texas does, nonetheless, differ from many other states in the history and pattern of its development. The presence of significant numbers of blacks historically engaged in farm pursuits and living in farm communities that were engulfed by metropolitan growth meant that a fair number of high-income suburban communities and their associated school districts had, with the eventual elimination of *de jure* school segregation, non-trivial numbers of black students

⁴ Differences between the PEIMS (Public Education Information Management System) from the State of Texas and the OCR data for 1992 suggest that the OCR either undercounted or undersampled Hispanics, which would lead to an overstatement of the decline in the white share of enrollment.

⁵ The pattern of residential segregation at the census tract level for the largest metropolitan areas (Dallas, Houston, and San Antonio) shows large declines in black-white segregation in the 1980s with a tapering off in the 1990s (Iceland and Weinberg (2002)). These aggregate statistics, however, mask considerable heterogeneity at the school district level.

⁶ It is not possible to quantify the extent to which this increase in residential segregation was a direct response to district desegregation efforts. Welch and Light (1987) provide overwhelming evidence of white flight in response to the implementation of desegregation plans, though Rivkin (1994) shows that between 1968 and 1988 the trend toward white exiting of central cities occurred regardless of whether segregation plans had been adopted. Recent data (1987-1996) show continued white movement away from districts schools with higher white exposure to nonwhites (Clotfelter (2001)). Moreover, Massey and Denton (1993) document that the pattern of suburbanization of blacks and whites carried many of the prior segregated housing arrangements to the suburbs.

attending these schools. It also led to the relatively dispersed pattern of attendance by blacks shown in Figure 1, where half of the black students attend schools in which one-third or less of student body is black. This pattern is an important source of variation that is not present in many other parts of the country and that contributes to the analyses that follow.

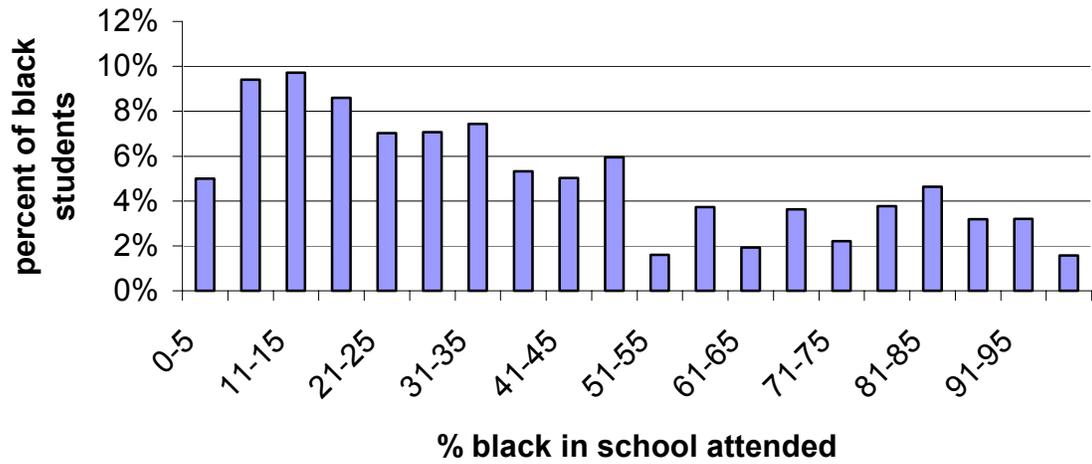
The overall distributional data show the patterns of racial exposure that have emerged in the schools, and they underscore the potential impediments for any changes, at least through the existing array of school based policies. More importantly for our purposes, they make abundantly clear that housing patterns and school district attendance policies combine to determine the distribution of students into schools. Because family and community differences are closely related to each of these factors, they clearly complicate the identification of an exogenous source of variation in school racial composition and make analysis of the effects of racial composition on student performance very difficult.

Prior research on racial peer effects

The academic literature includes a wide variety of analyses and perspectives on race and achievement. The only social science evidence of harm from school segregation cited by the U.S. Supreme Court in *Brown* involved psychological studies of black children that related low self-esteem to segregated schools.⁷ Many of the early (post-Brown) analyses concentrated on the effects of desegregation on achievement, self-esteem, and racial attitudes. These studies, which focused on short run effects of purposefully moving students to less segregated schools, consider a variety of student outcomes and yield mixed effects of desegregation (Crain and Mahard (1978), Cook (1984), Armor (1995)). Many desegregation plans ordered by courts were accompanied by conflict and resistance so that most short run investigations of the impact of integration on achievement are contaminated by factors related to the desegregation process.

⁷ Footnote 11 of *Brown* refers to the doll studies of Kenneth and Mamie Clark (Clark and Clark (1939)) that found that blacks in the segregated South tended to identify with white dolls and not black dolls.

Figure 1: Distribution of Black Students by Percent Black in School



Perhaps more important, however, these studies are plagued by methodological problems – largely related to sample selection issues but also including the heterogeneity of desegregation circumstances – making it difficult to assess the general impact of desegregation efforts.

Another segment of this literature focused not so much on student outcomes but on the impact of desegregation efforts on the subsequent racial composition of schools. Beginning with analysis of “white flight” in the face of court ordered desegregation by Coleman, Kelley, and Moore (1975), much of the analytical focus shifted to outcomes defined in terms of racial contact (Welch and Light (1987)).⁸

Finally, a related but distinct strand of research focuses on whether peer racial composition, as opposed to desegregation actions, affects achievement for blacks as well as for other demographic groups. This research does not consider the underlying determinants of racial composition but rather concentrates on its link with student outcomes. The landmark legislatively mandated civil rights report on *Equality of Educational Opportunity* (Coleman et al. (1966)) and its offshoot (U.S. Commission on Civil Rights (1967)) provided empirical evidence that racial isolation harms academic achievement,⁹ although this was soon questioned (Armor (1972)). Subsequent work by Crain (1970), Boozer, Krueger, and Wolkon (1992), Grogger (1996), and Hoxby (2000) finds that school racial composition affected academic, social, or economic outcomes. Hanushek (1972) finds that higher concentrations of blacks hurts both whites and blacks, but – related to the estimation developed below – is concerned that the racial composition of the school may simply be a proxy for heterogeneity in school quality and other omitted factors. Kain and O'Brien (2000), upon which this paper builds, find that blacks benefit a great deal from moving to the suburban schools that are more racially mixed. In contrast, Rivkin (2000) finds no

⁸ A related line of inquiry investigates racial composition and private schools (e.g., Clotfelter (1976)). Whether or not private schools tend to be more segregated than public schools has been the subject of considerable policy debate since Coleman, Hoffer, and Kilgore (1982). These issues are, however, beyond the scope of this analysis.

evidence that exposure to whites increases academic attainment or earnings for Black men or women in the high school class of 1982, and Cook and Evans (2000) indicate that little of the black-white difference in National Assessment of Educational Progress scores can be attributed to racial concentration. Finally, a more recent comprehensive review finds the evidence on achievement and psychological differences is very mixed Schofield (1995)).

The contrasting findings and lack of consensus concerning the importance of school racial composition likely emanate in large part from the difficulty of isolating the causal impact of peer characteristics. As Manski (1993), Moffitt (2001), and Brock and Durlauf (2001) point out, the empirical analysis of peer influences has been inhibited by both conceptual and data problems – problems that raise serious questions about interpretation of the existing studies, even those that use more sophisticated econometric techniques including instrumental variables.

While much of the theoretical literature on peer effects emphasizes the details of contemporaneous interactions among students, these issues, as we develop below, appear much less important than more standard ones related to inadequate controls for family background and prior schooling that lead to estimated coefficients that confound the true racial composition effects with common but unobserved elements of families, schools, and neighborhoods.¹⁰ For example, neither Crain (1970) nor Boozer, Krueger, and Wolkon (1992) provide many statistical controls for differences in socio-economic background or prior academic preparation.¹¹ Unlike the other papers, Grogger (1996) uses a longitudinal data set that contains information on family background and achievement measures, though it is unlikely that the study's small number of

⁹The Coleman Report data, collected in 1965, largely reflect the legal and behavioral equilibrium before court ordered desegregation efforts, because most desegregation plans were instituted in subsequent periods (Welch and Light (1987)).

¹⁰See Tiebout (1956) for a discussion of the link between family preferences and neighborhood location.

¹¹Boozer, Krueger, and Wolkon (1992) use two stage least squares in an attempt to control for nonrandom selection into integrated schools. The 2SLS estimates are much less precise than the OLS estimates; moreover, the instrumenting strategy uses variation across time and state in school racial composition, and such variation is likely to be correlated with other determinants of earnings.

variables would account for all factors that are related to both outcomes and the choice of schools. The inclusion of private school students in the analysis further increases the likelihood that the school racial composition coefficients are biased upward. Rivkin (2000) also uses longitudinal data and a school district aggregate measures of exposure to whites in order to overcome the nonrandomness of both neighborhood location within districts and attendance in non-neighborhood schools; nevertheless, unobserved differences among districts may still contaminate the estimate. Finally, Hoxby (2000) uses only that part of the variation in school racial composition that remains after removing school specific time trends in racial composition. While such cohort-to-cohort differences are not contaminated by long run trends in race or other factors that differ by school, it is highly unlikely that they are orthogonal to all other determinants of achievement given the high rate of student mobility, particularly among Blacks. Because the methodology in Hoxby (2000) is similar to that used in this paper, the details are best considered within the context of the general model described below.

Methodology

We begin with an explicit statement of how peers enter into the determination of achievement and use this to motivate our empirical strategy. The approach focuses attention on identification of the peer parameters of interest and controls for the most obvious sources of potential contamination through inclusion of a very general class of fixed effects in achievement gain and the inclusion of a number of time varying student and school characteristics. The remaining variation in school racial and peer composition provides a compelling source of identification of the relationship between achievement and peer demographic composition, though it does not identify the underlying pathways through which peers affect one another. The basic estimation is followed by a series of specification checks and extensions.

Empirical Model of Achievement with Peer Influences

Today's achievement is influenced not just by current family, school, and peer interactions but also by those of the past that establish the base for any current learning. This fundamental relationship is captured by Equation (1) that describes achievement (A) for student i in grade G, in school s,

$$(1) \quad A_{iGs} = \underbrace{X_{iGs}\beta_G + S_{Gs}\delta_G + \bar{P}_{(-i)Gs}\lambda_G}_{\text{current inputs}} + \underbrace{\sum_{g=1}^{G-1} X_{igs}\beta_g + \sum_{g=1}^{G-1} S_{gs}\delta_g + \sum_{g=1}^{G-1} \bar{P}_{(-i)gs}\lambda_g}_{\text{cumulative past inputs}} + \sum_{g=1}^G e_{igs}$$

where \bar{P} measures peer behavior and X and S are vectors of relevant family background and school inputs, respectively, and the subscript (-i) indicates that peer measures omit attributes of student i. Because it is useful for developing the estimation issues, this representation separates current and past influences.¹²

Much of the existing empirical work on the influences of peers – relying on just contemporaneous data on families, schools, and peers – concentrates on the direct investigation of how aggregate characteristics of the school such as racial composition or peer average ability influence current achievement. Yet, current peer group composition is almost certainly correlated with past peer group composition and other current and past determinants of achievement through the systematic choice of neighborhood and school by families. Because it is quite difficult to control for all relevant factors, estimation of Equation 1 using ordinary least squares or other single equation methods will tend under very general conditions to overstate the influence of peers (see Hanushek et al. (2003)).

Our approach to the general problem of estimating achievement relationships begins by taking the first difference of equation (1). Specifically, if A_{G-1} is determined by the same basic relationship as A_G , A_{G-1} includes all of the inputs through grade G-1. The specification of achievement in terms of growth, more commonly referred to as a value-added specification,

reduces the data requirements to the inputs relevant for grade G, since all of the historical influences on the current achievement level drop out. Equation (2) describes the value added specification:

$$(2) \quad \Delta A_{iGs}^c = X_{iGs}^c \beta + S_{Gs}^c \delta + \bar{P}_{(-i)Gs}^c \lambda + v_{iGs}^c$$

where ΔA_{iGs}^c is the achievement gain (difference between current grade and previous grade test scores) for student i in grade G in school s in cohort c .¹³ Student achievement growth is related to the contemporaneous inputs (which are the flows of these factors over the observed time period), and the generic problems of omitted historical variables are circumvented.¹⁴ Such estimation, which requires data with just two observations on each student, has been considered state of the art in estimation of achievement models (Hanushek (1986)).

The micro-level value-added specification does not, however, circumvent problems that arise from omitted or mismeasured contemporaneous factors. This issue is particularly important in the context of estimating peer influences on achievement growth for three reasons. First, the accumulated research on achievement determination has vividly demonstrated the difficulties in adequately characterizing not only schooling inputs but also individual ability and family inputs (see Hanushek (1986, (1997), Rivkin, Hanushek, and Kain (2001)). Second, systematic decisions about neighborhood and school choice by parents induce a well-documented correlation among family characteristics such as income, education, and race. Third, because many parents have better information about schools and other families in the neighborhood than the econometrician

¹² Presentation of achievement solely in terms of school experiences, ignoring preschool experiences, is done solely for expositional ease. Given our estimation strategy, it has no effect on the results.

¹³ This formulation does impose restrictions – chiefly, that the relevant past history is completely summarized by prior achievement, A_{G-1} . An alternative estimation approach is to add a measure of prior achievement to the right hand side. This approach does not constrain the parameter on prior achievement to be one but does add other complications with estimation (see Hanushek (1979), Rivkin, Hanushek, and Kain (2001)). The recognition of separate cohorts in the specification facilitates development of the subsequent estimation strategy.

¹⁴ This formulation assumes that current inputs do not affect the rate of learning in future periods. For example, the impact during the sixth grade of an exceptional fourth grade teacher is presumed to be captured fully by achievement at the beginning of the sixth grade. Violations of this assumption will bias

has, poorly measured school quality elements will be correlated with the aggregate measures of families such as average test score, income or racial composition usually included as peer group characteristics. These factors combine to elevate the importance of model specification in the case of peer estimation, because these omitted factors by themselves could make peers appear important even in the case when there is *no* achievement influence of peers (cf. Moffitt (2001), Hanushek et al. (2003)).

Other researchers, lacking micro data on individuals, have attempted to address these problems within the constraints of having just aggregate school level information for different cohorts. An approach for dealing with unobserved family and neighborhood factors is to construct aggregate differences across adjacent cohorts, what might be thought of as pseudo value-added estimation. This method, which builds on the intuition that students close in age in the same school have many similar experiences, has been used in a variety of circumstances (e.g., Ehrenberg and Brewer (1995), Ferguson and Ladd (1996), and more recently generalized by Hoxby (2000)). Hoxby's approach, which begins by removing time trends in racial composition, is particularly appealing when random year-to-year variation in birth rates for different ethnic groups living in each school attendance zone drives the remaining fluctuations in racial composition. Cohort to cohort differences in school racial composition (after removal of time trends) might then be presumed to be orthogonal to other determinants of achievement.

Yet, in actuality much of the cohort to cohort variation in racial composition for students past the very early grades stems from the substantial annual student mobility. In Texas, the site of both our work and that of Hoxby (2000), an average of over 20 percent of all students change schools each year, and mobility rates of black students are significantly higher than those for white and Hispanic students (Hanushek, Kain, and Rivkin (2001a)). Not only do the results in Hanushek, Kain, and Rivkin (2001a) show that moving students tend to suffer academically in the

downward the estimated effects of specific variables on achievement by ignoring their continued contribution.

year of a move, it also shows that average turnover in a school has negative impact on all students. When the effects of composition are identified from movers, a correlation with achievement is built in through the negative impacts of individual moving and overall school turnover. With aggregate school data as opposed to microlevel panel data, it is difficult to adjust both for these moving effects and for the many historical background influences that also vary between movers and stayers in the school. Finally, Hanushek, Kain, and Rivkin (2001b) also find year-to-year differences in student racial composition and student demographic variables directly affect the probability that teachers leave a school. Taken as a whole, the evidence strongly suggests that de-trended school racial composition does not provide an exogenous source of variation in the absence of a comprehensive set of controls for student mobility, teacher mobility and other contemporaneous and background factors whose year-to-year differences are correlated with those of student racial composition.

Rather than comparing the achievement of adjacent cohorts in a single grade we examine the detailed time path of achievement as different cohorts of students each progress through a given school. Essentially this approach identifies racial composition effects from the differences among cohorts in the grade-to-grade changes in racial composition.

From the starting point of equation (2), equation (3) decomposes the error, v , into a series of components highlighting those factors most likely to contaminate the peer estimates in a way that is consistent with our subsequent estimation.

$$(3) \quad v_{iGs}^c = \underbrace{\omega_i + \omega_{Gs}}_{\text{cross sectional}} + \underbrace{\delta_{ay} + \theta_{Gs}^c}_{\text{temporal}} + \varepsilon_{iGs}^c$$

The first two terms capture time invariant individual (ω_i) and school-by-grade effects on the gain in achievement (ω_{Gs}); controlling for these terms leaves only changes over time in grade specific school and student circumstances. The next term (δ_{ay}) captures important school and neighborhood components that vary from year to year for individual attendance areas (where a unique attendance area is defined for each middle school and its associated feeder primary

schools). The final factors, θ_{Gs}^c and ε , include elements common to a school and grade that vary over time (most importantly, teacher quality) and a random error capturing time varying individual achievement shocks, respectively.¹⁵

The key to estimating peer influences is ensuring that none of the components of v are correlated with the measured peer factors, particularly with racial composition. Our approach is to purge this composite error term of factors that would most likely drive any correlation, thus permitting direct estimation of the influence of racial composition. We discuss each component along with our estimation strategy to deal with it in turn.

Our estimation makes use of stacked panel data for successive cohorts explicitly to remove the first three components of the error term: fixed individual, school-by-grade, and attendance area-by-year effects. Given the removal of school-by-grade and student fixed effects, only the changes in racial composition caused by the movement of students among schools are used to identify the racial composition effects. This magnifies the importance of controlling for the direct effect of mobility and related factors, and we address this issue at length below.

Notice how the fixed effects account for the primary systematic but unobserved differences in students and schools. The student fixed effects (in the gains formulation of equation 2) account for all student and family factors that do not vary over the period of achievement observation and that affect the rate of learning – including ability differences, child rearing practices, general material inputs, consistent motivational influences, and parental attitudes towards schools and peers. Any stable differences in schools that are not perfectly correlated with the student fixed effects or included covariates (S and X) – but typically correlated with peer group composition through school and neighborhood choice – are accounted for school-by-grade fixed effects. These effects include not only elements of school quality, of teacher quality, and of curriculum that are fixed for our observation period but also systematic

¹⁵ In the empirical analysis, an additional fixed factor (τ_{Gy}) is always introduced to capture grade-by-year

within school changes in achievement gains as students age. For example, in the latter category, a given school may have a specific curricular emphasis, such as from specialized programs of a school or district, or achievement for students in some schools may historically tend to decline at the same time that the black share of enrollment rises (say, because nonblack families become more likely to remove their children from the public schools or to move to the suburbs as students age).¹⁶

Finally, the attendance area-by-year fixed effects capture the year to year differences in average school and school district quality that are likely to affect both student outcomes and parental choices of schools but does so in a much more flexible way than specifications that either include measured attributes or remove general linear or even polynomial trends.¹⁷ Since attendance areas tend to be geographically based, this fixed effect removes all variation over time in neighborhood and local economic conditions that likely affect mobility patterns including the existence of “transitional neighborhoods.” Of particular relevance to this work, districts develop policies related to racial composition of schools, desegregation plans, and other legal issues in the area. This range of policies and issues potentially affect student achievement directly along with being correlated with student movements into schools and districts – either because they are causally related through parental and district behavior or because they are simply coincidental in timing across districts in the state. School district policies and actions are of particular concern because a significant proportion of local policy is made at the district level including hiring practices and pay, teacher and principal assignments to schools, the determination of school attendance boundaries and placement rules, and the like – but they are fully incorporated into this estimation strategy.

differences in the testing regime. This term allows the mean test difficulty to vary by year for each grade.

¹⁶ Note that the school-by-grade fixed effects completely generalize any stable school effects by allowing for stable differences across grades within schools.

¹⁷ Note that this fixed effect completely subsumes any district wide effects that change over time. Our empirical analysis has substituted just district-by-year effects, but incorporating the additional detail guards

The key questions about this strategy of eliminating possible contaminants in the error term are: whether the remaining variance in school racial composition is large enough to identify racial composition effects, particularly if they are small; whether the remaining error term is orthogonal to confounding determinants of achievement; and whether small grade-to-grade changes in racial composition actually affect classroom performance.

On the first question, the high rate of mobility of students in Texas public schools generates sizeable year and grade specific differences in racial composition so that even the removal of attendance area-by-year and school-by-grade fixed effects leaves substantial variation in school racial composition. Of course this mobility raises the possibility that factors associated with moving (beyond the extensive controls for observable and unobservable student and school factors) confound the estimates.

The likelihood that endogenous mobility contaminates the estimates significantly depends upon the speed with which families relocate in response to expected problems in the coming school year. Residential moving is a costly process and frequently involves multiple children in different grades. The implied slow adjustment suggests that movement due to parental selectivity of schools is almost certainly much slower than the movement of peer characteristics found in natural year-to-year variations. With the removal of attendance area-by-year fixed effects, the only concern is idiosyncratic grade specific variations (i.e., $\theta_{G_s}^e$) that are systematically correlated with changes in racial composition. Parents may anticipate changes in teacher quality, for example, but such information about individual schools is not generally available before the year begins. Moreover, the assumption that families also react slowly (i.e., not in the current year) to specific variations in teacher quality also seems natural, suggesting that year-to-year changes in teacher quality are unlikely to be systematically linked with changes in peer group composition. Families are much more likely to react to overall changes in

against the possibility that subareas within large districts face systematically different influences on their

neighborhood or school quality or grade specific factors, all of which are removed by the school-by-grade and attendance area-by-year fixed effects.¹⁸

Nevertheless, we account directly for intertemporal changes in measured teacher and school characteristics and student mobility in order to eliminate problems caused by these potentially confounding factors.¹⁹ The grade specific teacher and school characteristics include information on teacher experience, turnover and class size. Comprehensive information on student mobility includes a full set of dummies that control for the timing, frequency and destination of student moves and grade specific controls for average student turnover that may be related to changes in percent black and not accounted for by the attendance area-by-year fixed effects. We also produce separate estimates of racial composition effects by student mobility status in order to make sure that movers do not drive the results.

A final concern is that explicit classroom placement policies could generate a spurious correlation between achievement and racial composition that is not removed by the fixed effects or time varying variables. This classroom placement problem is handled, however, by aggregating classrooms to the grade level.²⁰ With that, the racial composition effects are estimated from shifts in composition across grades and across cohorts and the time invariant placement practices by school and grade are removed with the fixed effects. Thus, it is unlikely that purposeful placement patterns would vary with yearly patterns in racial composition across grades in a systematic way that would bias the estimates.

schools.

¹⁸ Our direct analysis of student mobility also suggests that within district moves (which are particularly important for changes in racial composition) are not strongly motivated by “Tiebout” choices of school quality (Hanushek, Kain, and Rivkin (2001a)).

¹⁹ The specifications of time varying factors come from our prior analyses identifying specific teacher and school factors (Rivkin, Hanushek, and Kain (2001)) and the relevant dimensions of student mobility (Hanushek, Kain, and Rivkin (2001a)).

²⁰ This estimator is equivalent to using the grade average as an instrumental variable. While other approaches for dealing with within school placement may conceptually be available, our data do not permit such matching, and we do not pursue any such strategies here. Clotfelter, Ladd, and Vigdor (2002) investigate segregation by district, school, classroom, and academic track for seventh graders in North Carolina. They find significant variations in racial composition of classrooms along with large differences

These myriad controls almost certainly identify an exogenous source of variation in racial composition, but a remaining question is whether students actually respond to small, year-to-year differences in a similar way to longer term differences in the peer and schooling environment. Small changes in peer composition for non-movers who retain most of their friendship group from year to year may have very little impact on student behavior with the possible exception of any teacher response to classroom composition. Students who switch schools, on the other hand, experience the most pronounced changes in peer environment, but the other disruptions associated with moving including the transitional period of school adjustment may attenuate any effects of peer composition in the short term. Fortunately, there is a third group of students that transitions from primary to middle school and experiences meaningful changes in classroom and peer environment. These “structural moves” do not entail any reaction to specific time varying differences in school quality, and, because they typically involve substantial changes in peer relationships, are likely to capture most clearly the impact of peer group composition on achievement.

Peer Structure

To this point the discussion has focused on the special econometric complications of peer estimation but not on specification and interpretation of peer influences themselves. The common conceptual discussion of peers revolves around social interactions in terms of motivations, direct educational inputs, or even the externalities in the classroom through, say, the quality of individual discussion, attitudes or expectations of teachers and questions or pure disruptive behavior (cf. Lazear (2001)). Most investigations of peers, however, never observe or measure any attributes of actual behavior but instead include aggregate observable characteristics of the students such as race, income, or ability. This approach, which we also follow, essentially extracts common elements of average behavior. It does stop short of taking the analysis to a more

in the probability of new teachers for blacks, but they do not look at its implications for student performance.

fundamental behavioral level that recognizes the heterogeneity of the aggregate racial, income, and ability categories, largely because little is known or systematically observed about more basic behavioral factors. Thus, for example, the initial doll studies that partially motivated the *Brown* decision considered how children in segregated environments formed notions of racial identity but did not investigate the range of heterogeneity related to family, neighborhood, or school differences in the reactions of black children. As a result, the simple depiction of mean differences in outcomes by race, income, or other factors is best thought of as a reduced form relationship that aggregates underlying behavior across readily identified but crude categories.

Equation (4) follows convention and describes the link between peer behavior and measured peer composition in each year as a simple linear function of classmate aggregates:

$$(4) \quad \bar{P}_{(-i)Gs} = B_{(-i)Gs}\gamma_B + H_{(-i)Gs}\gamma_H + \Gamma_{(-i)Gs}\gamma_A + Y_{(-i)Gs}\gamma_Y + u_{(-i)Gs}$$

where B is proportion black, H is proportion Hispanic, Γ is peer average ability or cognitive skill, Y is a measure of peer family income, and u is an error term that captures all other influences on peer behavior.²¹

The substitution of proportion black, proportion Hispanic, and peer average ability (measured by past achievement of the current collection of classmates) in place of peer behavior produces the reduced form specification that forms the basis of our empirical analysis.²²

$$(5) \quad \Delta A_{iGs}^c = X_{iGs}^c \beta + S_{Gs}^c \delta + B_{(-i)Gs} \gamma_B + H_{(-i)Gs} \gamma_H + \Gamma_{(-i)Gs} \gamma_A \\ + \omega_i + \omega_{Gs} + \tau_G^c + \delta_{dy} + (\theta_{Gs}^c + \varepsilon_{iGs}^c + \nu_{(-i)Gs}^c)$$

In this simple framework the coefficients on the observed peer group characteristics will reveal the link between achievement and these variables but not the underlying relationships between

²¹ Note that all peer variables omit the individual from the calculations, i.e. they refer to schoolmate and not school simply school characteristics because the latter would necessarily confound individual and peer effects.

²² Note that throughout the paper we use “ability” as a shorthand for (fixed) prior achievement levels – without connoting anything about the source of differences. Preliminary work found that none of the other peer variables were sensitive to the inclusion of the peer income variable (percentage of students eligible

these variables and specific peer behavior (such as disruptions per class period) and between that peer behavior and achievement. Of course the assumption that peer behavioral influences can be adequately compressed into a single dimension (P) is likely to miss much of the complexity and heterogeneity of classroom interactions. Nevertheless, these reduced form coefficients provide the relevant information for policies related to racial composition. Moreover, we are able to explore the possibility that the racial composition effects are nonlinear or that they differ by initial achievement, race or ethnicity. Finally, by alternately including and then excluding the measure of peer average ability we can learn a great deal about the extent to which average achievement differences among race/ethnic groups account for any observed link between racial or ethnic composition and achievement.²³

Other Issues and Extensions

First, much of the conceptual and descriptive discussion of peer influences is vague about the nature of peer group formation, though most analyses simply average across all of the students in a school.²⁴ If, however, there is substantial within school segregation by race or ethnicity in terms of social interactions, only characteristics of same race/ethnic peers may be important. In such a case, school wide averages will provide noisy measures of peer average achievement or income that lead to underestimates of the effects of these variables. By alternately

for a subsidized lunch). Because this measure of income is noisy and in part dependent on the effectiveness of schools in obtaining information on family income, it is omitted from the subsequent empirical analysis.

²³ The average of peers' achievement two years earlier rather than current achievement captures stable cognitive ability differences but does not include any measures of the contemporaneous innovations in achievement that might reflect interactive behavior. While current peer average achievement provides a better measure of contemporaneous peer ability, its inclusion would raise the essentially insoluble reflection problem described by Manski (1993). The use of past average achievement (for current classmates) likely introduces a small amount of measurement error when contemporaneous achievement accurately measures the true influences, but empirically the pattern of changes in the racial composition coefficients is virtually identical regardless of whether lagged or current achievement is used to capture peer achievement differences. See Hanushek et al. (2003) for a detailed discussion of this issue. In her cohort trend analysis, Hoxby (2000) uses of average current achievement differences across ethnic groups to infer whether the racial composition effects are driven by achievement differences, but such differences are endogenous and are likely result from a variety of unmeasured factors including differences in teacher quality.

²⁴ See Manski (1993) and Moffitt (2001) on the issues of endogenous peer group formation.

including all schoolmates or separating same race/ethnic and other schoolmates in the calculation of peer average achievement, we can learn more about the nature of peer group relationships.

Second, the historical patterns of desegregation of schools are quite varied. Since *Brown*, some districts have gone through traumatic times of involuntary desegregation of schools, while others have moved easily from all white schools to stably integrated schools. Most of the development of court supervised integration plans occurred in the 1960s, 1970s, and early 1980s, before any of our observations of student performance. Therefore two schools with similar racial compositions in the mid-1990s could have arrived at that point in very different ways. While we do not have the details of the ways in which these changes occurred – say, by legal action, white flight, or new housing developments – we can investigate whether the time path of change in racial composition influences the social interactions captured by the racial peer effects on achievement.

UTD Texas Schools Data

The cornerstone of the analysis of racial composition effects on achievement is a unique stacked panel data set of school operations constructed by the UTD Texas Schools Project, a project conceived of and directed by John Kain. The data we employ track the universe of three successive cohorts of Texas public elementary students as they progress through school. For each cohort there are over 200,000 students in over 3,000 public schools. Unlike many data sets that sample only small numbers from each school, these data enable us to create quite accurate measures of peer group characteristics. We use data for grades four through six for the last cohort and grades four through seven for two earlier cohorts. The most recent cohort attended 5th grade in 1996, while the earliest cohort attended 5th grade in 1994. Only black, Hispanic, and white students are included in the analysis though all students are used in the calculations of peer characteristics; the relatively small numbers of Asian and Native American students are excluded in order to simplify estimation of the models.

The student data contain a limited number of student, family, and program characteristics including race, ethnicity, gender, and eligibility for a free or reduced price lunch (the measure of economic disadvantage) and Title I services. The panel feature of the data, however, is exploited to account implicitly for a more extensive set of background characteristics by removing time invariant individual effects on achievement gains. Importantly, students who switch schools can be followed as long as they remain in a Texas public school.

Beginning in 1993, the Texas Assessment of Academic Skills (TAAS) was administered each spring to eligible students enrolled in grades three through eight. The criteria referenced tests evaluate student mastery of grade-specific subject matter. This paper presents results for mathematics, although the results are qualitatively quite similar for reading. Consistent with the findings of our previous work on Texas, schools appear to exert a much larger impact on math than reading in grades 4 through 7 (see Hanushek, Kain, and Rivkin (2002) and Rivkin, Hanushek, and Kain (2001)).²⁵ Each math test contains approximately 50 questions. Because the number of questions and average percent right varies across time and grades, we transform all test results into standardized scores with a mean of zero and variance equal to one, which transforms the outcome into a measure of relative position in the achievement distribution. The regression results are robust to a number of transformations including the raw percentage correct. In order to avoid complications associated with classification as limited English proficient (LEP) or disabled, all LEP and special education students are dropped from the direct achievement analysis, although these students are included in the peer calculations.

Importantly, the student database can be linked to information on teachers and schools. The school data contain detailed information on individual teachers including grade and subject taught, class size, years of experience, highest degree earned, and student population served. While individual student-teacher matches are not possible, students and teachers can be uniquely

related to a grade on each campus. Each student is assigned the average class size and the distribution of teacher experience and turnover for teachers in regular classrooms for the appropriate grade, school, and year.

Empirical Results

The basic investigation considers the overall impact of racial composition on student achievement, while extensions consider possible nonlinearities and other complications previously noted. It begins with simple models of the level and gain in achievement and expands the specifications by adding individual, school-by-grade, and attendance area-by-year fixed effects, measured teacher and school characteristics, and the achievement level of peers.²⁶ Throughout the analysis, the effects of racial composition and other peer characteristics are estimated separately for black and white students.²⁷

Baseline Results

Table 3 presents school racial composition coefficients from progressively richer specifications. While the simple model describing the level of achievement (column 1) indicates that achievement is lower in schools with higher proportions of black and Hispanic students, it is not possible to conclude that these are true causal effects. Racial composition of the school is

²⁵ Part of the difference between math and reading might relate specifically to the TAAS instruments, which appear to involve some truncation at the top end. For math, the outcomes are less bunched around the passing scores than they are for reading.

²⁶ A number of included variables, reported in the tables, are based on findings about specific factors affecting achievement growth (Rivkin, Hanushek, and Kain (2001), Hanushek, Kain, and Rivkin (2001a)). At the individual level, all specifications include indicators for different types of school-to-school moves and an indicator for free lunch eligibility. Specifications that do not remove fixed effects contain dummy variables for the race, gender and ethnicity of each child, a full set of grade-by-year indicators, and dummy variables for community type. Estimates involving measured teacher and school characteristics include the rate of school transfers by students; the proportion of teachers with zero years of experience; and class size (all calculated by grade and subject). Preliminary specifications also included a measure of teacher turnover that was found to have no significant effect, and its exclusion had virtually no impact on the other coefficients. Because some prior work suggests that class size and experience effects are larger for lower income students, these variable effects are permitted to differ for blacks and Hispanics.

²⁷ Similar analysis was conducted for Hispanic students. While the aggregate results were quite similar to those for whites, we were concerned about the heterogeneity of the Hispanic population. Some are very recent immigrants with English language deficiencies, while others have been Texas residents for many

Table 3. Effects on Mathematics Achievement Level and Achievement Gains of Peer Racial Composition^a (absolute value of Huber – White adjusted t-statistics in parentheses)

Level (A _i)	Achievement growth (ΔA_i)			
	Without measured teacher and school characteristics	With measured teacher and school characteristics ^b		
	<i>Student and school-by-grade fixed effects</i>	<i>Student and school-by-grade fixed effects</i>	<i>Student, school-by- grade, and attendance area-by- year fixed effects</i>	
Blacks				
Proportion black (γ_B)	-0.22 (5.31)	-0.30 (2.87)	-0.21 (2.01)	-0.22 (2.34)
Proportion Hispanic (γ_H)	-0.12 (2.73)	-0.04 (0.42)	0.03 (0.33)	0.13 (1.58)
Whites				
Proportion black (γ_B)	-0.11 (3.25)	-0.12 (1.16)	-0.13 (1.28)	-0.11 (1.17)
Proportion Hispanic (γ_H)	-0.03 (1.68)	0.06 (0.76)	0.03 (0.41)	0.13 (1.85)
Test of black-white equality for proportion black effect ^c	.03	.00	.07	.01
sample size	378,512	1,013,749		

- Notes:
- For description of the complete specifications, see Equation 5 and footnote 26.
 - Models include teacher characteristics (experience categories), class size, and grade level student turnover.
 - P-values from t-test for $H_0: \lambda_{\text{black}} = \lambda_{\text{white}}$; $H_1: \lambda_{\text{black}} \neq \lambda_{\text{white}}$

intertwined with various historical individual and school differences, and thus the simple aggregate achievement differences across schools cannot be readily interpreted.

The final four columns provide estimates from the models that incorporate progressively more detailed characterizations of individual, school, and district factors that might affect achievement growth. The student and school-by-grade fixed effects in achievement growth (Column 2) are supplemented with measured teacher, school and other student characteristics (Column 3), and then attendance area-by-year fixed effects (Columns 4).

The basic student and school-by-grade fixed effect results suggest that a higher proportion of black schoolmates significantly reduces the achievement of black students. However, the inclusion of controls for teacher characteristics, student turnover and class size reduces the estimated effect of percent black by roughly one-third. It appears that the fixed effect estimates in models that lack these time varying variables confound the effect of school racial composition with that of inferior school characteristics (measured by class size, teacher experience, and school turnover) that are correlated with racial composition across Texas schools in a complicated way. In contrast, the inclusion of attendance area-by-year-fixed effects that capture changes in neighborhood environment and school leadership, curriculum, student and teacher assignment policies, or other factors that may be linked with changes in student racial composition has virtually no additional effect on the estimates of racial composition (column 4).²⁸ These results provide strong evidence that the estimates are not being driven by a pattern of unobserved changes in school or neighborhood factors that lead to changes in racial composition.

The magnitude of the proportion black coefficient for blacks of -0.22 suggests that a 10 percentage point reduction in percentage black would raise annual achievement growth by 0.022 standard deviations. These estimated effects apply to the growth of annual achievement and thus

generations. Follow-on analysis is designed to provide background and programmatic detail for analysis of the Hispanic population.

²⁸ Other estimation (not shown) included district-by-year effects instead of attendance area-by-year effects but had virtually no effect on the estimates of the effects of racial composition.

accumulate over grades. Our estimation, which applies to grades 5-7, does not provide information on the effects of racial composition for earlier or later years of schooling. Nonetheless, as we discuss below, the coefficient magnitude implies a substantial role for school racial composition in the determination of the racial achievement gap, even if the effects are not extrapolated to other grades.

The character of results for white students differs from those for blacks. First, the estimated effect of proportion black is much smaller (slightly over half as large) and not statistically significant at any conventional level in any of the fixed effect specifications. As shown at the bottom of the table, the hypothesis that the effects for Blacks equals that for Whites is rejected at the 1 percent significance level in the full model estimates.²⁹ Note also that this is a pure “black composition” effect and not a “minority composition” effect. The proportion Hispanics, if anything, positively affects both black and white achievement, although the estimates are insignificant at conventional levels.

We think the estimated racial composition effects are most clearly interpreted as pure peer effects and not, for example, unmeasured other aspects of schools. Nonetheless, under two strong assumptions, the estimated impact of racial composition on whites can be used to establish a lower bound for the black peer effect. If whites are subject to *no* black peer effects and if the white coefficient simply reflects any reduced school quality correlated with higher concentrations of blacks, the difference in the black and white coefficients could be interpreted as the lower bound for black peer effects.³⁰ As demonstrated below, this lower bound estimate – roughly half that previously calculated – still represents a very substantial effect.

²⁹ The aggregate estimates for Hispanics are very similar in magnitude to those for whites, but the heterogeneity of Hispanic students complicates any interpretation.

³⁰Note that this ignores the statistical insignificance of the white estimates and relies simply on point estimates. The aggregate estimates for Hispanics are very similar in magnitude to those for whites and also are statistically insignificant. Thus, the lower bounds calculated from Hispanics are essentially the same as those for whites.

A complementary investigation of the source of this black composition effect included separating any effects of altered peer achievement from the racial composition effect. For this, peer ability is measured by achievement of the current grade-level peer group for each student lagged two years to avoid the complications of the reflection problem.³¹ The separate estimates of the basic models including measured teacher and school effects and school-by-grade fixed effects yielded virtually no change in the impact of proportion black on either black or white performance. Neither did it matter to identify the ability of just own-race peers. Nonetheless, with the additional inclusion of attendance area-by-year fixed effects, the estimates of racial composition and ability became unstable. It appears that the elimination of variation through the most detailed models does not allow accurate separation of race and ability effects.

Differences by 3rd Grade Achievement Quartile

One important question, raised by a variety of researchers, is whether the school racial composition effect varies across the achievement distribution. To examine the possibility that racial composition effects vary with a student's initial achievement, we interacted percent Black with indicators for a student's position in the overall state achievement distribution. Specifically, we divide students into achievement quartiles on the basis of each student's third grade mathematics test score. This produces four separate estimates of the percent black effects varying by performance quartile (and also by race). The specifications displayed all include time varying teacher, school, and other student characteristics along with student, school-by-grade, and attendance area-by-year fixed effects.

The results in Table 4 support the view that higher achieving blacks are much more sensitive to school racial composition: the coefficients, while statistically insignificant for the bottom quartile, increase monotonically along the initial achievement distribution. The hypothesis that the effect of percent black is equal across the achievement distribution is rejected at greater

³¹ This formulation assumes that it is the ability characteristics of the peer group and not any contemporaneous behavior arising from achievement levels but different from prior performance that is

Table 4. Effect on Mathematics Test Score Gains of Proportion Black Students by Race and Quartile of the State Test Score Distribution

(absolute value of Huber-White adjusted t statistics in parentheses)

	Quartile of Distribution of Third Grade State Scores:			
	Bottom Quartile	Second Quartile	Third Quartile	Top Quartile
Blacks				
Proportion black (γ_B)	-0.17 (1.75)	-0.20 (2.02)	-0.28 (2.82)	-0.38 (3.56)
Whites				
Proportion black (γ_B)	-0.08 (0.79)	-0.14 (1.50)	-0.08 (0.87)	-0.12 (1.28)

Note: Position in the achievement distribution is based on the student's third grade test score. Estimates correspond to column 4 of Table 3 and include student, school-by-grade, and for attendance area-by-year fixed effects along with class size, teacher characteristics, and student turnover. See also Equation 5 and footnote 26 for description of the specification. F-tests of the probability that the effects are equal across the achievement distribution have p values of 0.00 for blacks and 0.40 for whites.

than the one percent level for blacks but not at any conventional level for whites (see the note to Table 4). In addition, the estimated effects for whites remain uniformly smaller and less significant than those for blacks, indicating that a higher proportion black does not appear to affect all higher achieving students similarly via curriculum decisions or other paths common to all students in the school. Rather the deleterious effects appear again to be much stronger for blacks than for whites with the largest differences for the top ability groups.

The results in Table 4 paint a more complex picture of the link between achievement and racial composition. It appears that the upper end of the black achievement distribution is squeezed toward the median. This likely reduces black rates of college attendance, graduation, and employment in highly skilled and rewarding occupations. On the other hand, school racial composition appears to have a far smaller impact on blacks at the lower end of the achievement distribution.

As noted, we do not observe peer interactions but instead infer their character from the achievement outcomes. But questions remain about the details for different ability groupings. Specifically, is the essential element where a black student falls in the overall ability distribution (absolute achievement) or where the student falls in the school distribution (skill relative to schoolmates)? Table 5 provides clear evidence on this by dividing students simultaneously in terms of the overall state achievement distribution and the school distribution. For blacks, the estimated impact continues to rise along with the position in the state achievement distribution, but within each third of the overall distribution there is little or no evidence of a systematic ordering by position in the school distribution.³² Moreover, separate estimates by position in the school achievement distribution alone (not shown) reveal no systematic ordering for blacks. For

important. See Hanushek et al. (2003), Brock and Durlauf (2001), and footnote 23, above.

³² Note that students are divided into thirds of the distribution in order to have reasonable numbers of black students within each state-school cell. Still, some of the cells (e.g., top third of the state distribution and bottom third of the school distribution) are essentially empty – less than 0.2 percent of the students – and estimates are not reported for them.

Table 5. Effects on Math Achievement Gains of Proportion Black Students by Position in Statewide and in School-wide Distribution of Ability^a

	Blacks		Whites	
	Coefficient (γ_B)	Frequency	Coefficient (γ_B)	Frequency
Bottom third of total distribution				
bottom third of school distribution	-0.16 (1.56)	44.65	-0.22 (2.04)	23.13
middle third of school distribution	-0.13 (1.22)	6.85	-0.07 (0.61)	2.22
top third of school distribution	b	b	b	b
Middle third of total distribution				
bottom third of school distribution	-0.25 (2.11)	5.04	-0.01 (0.08)	8.43
middle third of school distribution	-0.28 (2.69)	21.99	-0.09 (0.88)	25.63
top third of school distribution	-0.21 (2.00)	4.35	-0.11 (1.07)	2.81
Top third of total distribution				
bottom third of school distribution	b	b	b	b
middle third of school distribution	-0.44 (3.44)	3.18	-0.14 (1.31)	8.78
top third of school distribution	-0.37 (3.39)	13.80	-0.14 (1.54)	28.83

Note: a. All regressions include student, school-by-grade, and district-by-year fixed effects plus class size, teacher characteristics, and student turnover; see Equation 5 and footnote 26.

b. Cell includes less than 0.2 percent of student distribution.

whites, the point estimates remain much smaller and statistically insignificant (except for the lowest achieving white in both the absolute and relative distribution).

These results are consistent with some existing hypotheses. But with our data we cannot pursue the underlying source of the racial composition effect. A variety of researchers, commentators, and community leaders emphasize that some blacks discourage others from excelling academically, but this view remains controversial. (See, for example, Fordham and Ogbu (1986), Cook and Ludwig (1997), Steele and Aronson (1998), Ainsworth-Darnell and Downey (1998), Ferguson (1998, (2001), McWhorter (2000), and Bishop et al. (2001)). Alternatively, others suggest that teachers lower expectations for black students as the proportion of students who are black rises. Each of these explanations would tend to produce a stronger relationship between achievement and proportion black for blacks at the higher end of the initial achievement distribution.

Patterns of Racial Composition

The prior analysis concentrates on the overall effects of racial composition across all of Texas. As described, however, the State of Texas is a composite of highly different communities with different histories and different development patterns. While many of the larger districts are still operating under court supervised desegregation plans that emanated from the days of *de jure* school segregation, no consistent data across Texas districts are available on even the existence of such legal plans let alone their nature. Nor is systematic information available on the community reactions to any court ordered or voluntary integration of schools, whether current or past. Nonetheless, because some of the early investigations of court ordered desegregation suggested that the dynamics of integration within communities are important, we attempted an exploratory investigations of how varying paths of racial composition affects its impact on achievement. Employing the sample of 62 districts surveyed consistently over time by the Office of Civil Rights, we identified districts on the basis of changes in black exposure to white students (by school) between 1968 and 1992: increase exposure of 10 percent or more (27 districts), decreased

exposure of 10 percent or more (15 districts), and the remainder (20 districts). Estimation of the basic achievement models but allowing the effects of racial composition to vary across the three subsets of districts yields no systematic patterns (not shown). The reduced samples yield much less precise estimates, and the point estimates indicate no obvious pattern.³³

Districts in Texas also vary dramatically in terms of the levels of racial exposure. As shown in Figure 1, there are a number of districts with few minority students, while other districts have very high levels of minority concentration. The possibility that the effect of percent black rises or falls as percent black increases led us to investigate the presence of such nonlinearities. However, after looking at up to quartic relationships in racial composition, we found no systematic effects above the linear estimates presented above. In perhaps the most persuasive analysis, we divided schools into those with 0-33, 34-66, and 67-100 percent black and considered differential effects of racial composition. The estimates, while imprecise particularly in the bottom range, show the same basic effects, and coefficient equality could not be rejected at standard levels.

Source of Variation in Racial Composition

The prior analysis aggregates estimated impacts of black composition that, while all driven by underlying mobility of students across schools, are identified in different ways. Specifically, some students remain in same school but face differing racial compositions because others are moving; another set changes actual schools or districts, yielding differing peer compositions across time; and a final group, including virtually all of the students in our sample at one point or another, transitions from primary to middle school and faces a peer group frequently obtained from more than a single feeder school. Movers are potentially the most problematic, because their choices of schools could conceivably proxy elements of school quality,

³³ The rapid growth of Texas population and the new patterns of spatial development lead to recent changes in racial compositions of schools, and our future research plans call for extending the time period of achievement observations in order to investigate these new patterns in more detail.

family motivation, or the like and thus bias the estimates of racial composition.³⁴ Nonmovers, who are likely to retain much of their existing peer group, are expected to be less influenced by year to year changes in the racial composition of a grade. On the other hand, those undergoing structural moves, which are likely to lead naturally to larger changes in the relevant peer group, provide the clearest observations of the effects of racial composition. The direct effects of these various transitions are accounted for by school-by-grade fixed effects and by indicators for type of move for students changing schools. Our interest, however, is how differing ways of changing the relevant peer group (with differing underlying dynamics of peer behavior) affect our estimates of the effects of black peer composition.

Table 6 shows clearly that the prior results are not being driven by movers. These models use the most refined specifications (the final column of Table 3) but disaggregate the estimated racial composition effect by the source of identification. The racial composition effects for both black and white movers are small and statistically insignificant at any conventional level.³⁵

The estimated effect of racial composition for both blacks and whites is larger and much more significant for structural moves, the place where short run peer changes are likely to be larger and most informative. The magnitude of the estimates increase by over ten percent for blacks and over 50 percent for whites compared to the prior aggregated estimates, although the effect on blacks remain significantly greater. The earlier analysis nonetheless highlighted the apparent heterogeneity of effects by ability, and it is important to follow that line.

Table 7 generalizes this investigation to differential effects of racial composition by ability group. For blacks the pattern is quite similar to that observed for all students combined, though the effects are systematically larger for those making structural moves. For whites on the other hand, the division by mobility status leads to a sharp divergence from the aggregate results.

³⁴ Hanushek, Kain, and Rivkin (2001a) document that moves are actually motivated by a wide variety of family circumstances that are unrelated to school quality. The analysis here allows for the possibility that the subsequent schooling choice could still be correlated with racial composition of schools.

Table 6. Effect on Mathematics Achievement Gains of Peer Racial Composition by Source of Variation and Race of Student

(absolute value of Huber –White adjusted t-statistics in parentheses)

Source of variation in racial composition	Blacks	Whites
Nonmoves ^a (γ_B)	-0.06 (1.62)	-0.10 (2.57)
Structural moves ^b (γ_B)	-0.25 (6.71)	-0.18 (4.15)
Actual moves ^c (γ_B)	-0.04 (1.31)	0.03 (0.83)

Note: All regressions include student, school-by-grade, and attendance area-by-year fixed effects plus class size, teacher characteristics, and student turnover; see also Equation 5 and footnote 26.

- a. Effect of racial composition on students who remain in the same school across grades.
- b. Effect of racial composition on students who change schools school because of move from elementary to middle school.
- c. Effect of racial composition on students who change schools for other than a structural move.

Table 7. Effect on Mathematics Achievement Gains of Peer Racial Composition by Source of Variation, Race of Student, and Quartile of the Ability Distribution

(absolute value of Huber –White adjusted t-statistics in parentheses)

Source of variation in racial composition	Quartile of Distribution of Third Grade State Scores:			
	Bottom Quartile	Second Quartile	Third Quartile	Top Quartile
Blacks				
Nonmoves ^a (γ_B)	0.01 (0.38)	-0.05 (1.51)	-0.14 (3.49)	-0.26 (5.83)
Structural moves ^b (γ_B)	-0.19 (5.69)	-0.27 (7.36)	-0.31 (7.88)	-0.35 (8.18)
Actual moves ^c (γ_B)	-0.01 (0.37)	-0.02 (0.75)	-0.09 (2.32)	-0.14 (3.14)
Whites				
Nonmoves ^a (γ_B)	-0.04 (0.85)	-0.01 (0.22)	-0.17 (4.41)	-0.16 (4.21)
Structural moves ^b (γ_B)	-0.34 (7.05)	-0.16 (3.55)	-0.15 (3.88)	-0.06 (1.53)
Actual moves ^c (γ_B)	0.00 (0.00)	0.06 (1.33)	0.01 (0.20)	0.06 (1.66)

Note: All regressions include student, school-by-grade, and attendance area-by-year fixed effects plus class size, teacher characteristics, and student turnover; see also Equation 5 and footnote 26.

- a. Effect of racial composition on students who remain in the same school across grades.
- b. Effect of racial composition on students who change schools school because of move from elementary to middle school.
- c. Effect of racial composition on students who change schools for other than a structural move.

Specifically, the preferred estimates based on structural moves show that low achieving whites suffer the greatest harm from an increase in proportion black, while the negative effects for whites in the upper two quartiles continue to be roughly half as large as those for blacks. In fact, the aggregated results for white structural moves are clearly being driven by the impact on low ability white students. By these estimates, low ability whites react even more strongly than low ability blacks to variations in the proportion black students. There are no obvious explanations for this result, and it merits further investigation.

This more detailed investigation provides added support to the interpretation of strong racial composition effects operating through peer influences. It also strengthens the view that these effects are complicated, varying by ability group.

Conclusions and Implications

The difficulties of isolating school and peer group effects have been well documented. The role of peers, particularly in the context of racial integration, can be complex. By using a very large, matched panel data set from the state of Texas, we overcome many of the myriad methodological problems that impede the estimation of these effects.

The pattern of estimates supports the view that school proportion black has a negative effect on mathematics achievement growth for blacks that is concentrated in the upper half of the ability distribution. These racial composition effects for high ability blacks appear to be much stronger than those for lower ability blacks. What is particularly important is that this effect does not appear to be driven by school quality differences, achievement differences of classmates, or even the specific distribution of ability within the school (as opposed to across the entire state distribution). While any interpretation would be speculative, the results are consistent with the

³⁵ Nonmoving whites appear to respond significantly to black composition, but as described below there are interactions with student ability.

views that blacks impose peer pressure on other blacks not to achieve and that a higher proportion black may lead teachers to reduce their expectations for all blacks.

The magnitude of the black composition effects is significant. The typical black student (regardless of achievement quartile) has 30 percent greater black classmates than the typical white and has 25 percent more black classmates than would be obtained with a completely even distribution of blacks across the state (see Appendix Table A2). From our overall estimate of the impact of racial composition on black performance (Table 3), equalizing the black distribution throughout the entire state for just grades 5-7 (our observation period) would be consistent with an increase in black seventh grade achievement of 0.17 standard deviations.³⁶ This amounts to slightly more than one-quarter of the seventh grade achievement gap between blacks and whites

Of course the fact that the estimated adverse impact of racial composition increases in magnitude with the student's own achievement level indicates that the negative effects of black concentration on the racial achievement gap are disproportionately borne by blacks with higher academic achievement in the early grades. Blacks in the different quartiles of the ability distribution face essentially the same distribution of school racial composition in Texas; e.g., blacks in the bottom quartile in terms of third grade math achievement averaged 39 percent black classmates, while those in the top quartile averaged 43 percent (Appendix Table A2). Twenty-nine percent of black students fall in the top half of the third grade state math distribution (Appendix Table A1). By the estimates from Table 4, they suffer 44 percent of the aggregate loss from the uneven racial distribution. Blacks in the top quartile represent less than 10 percent of the black students but bear almost 20 percent of the cost of the existing segregation of students across schools.

Note, moreover, that these are estimates of the pure racial composition effect. They say nothing about whether the school quality faced by the typical black is above or below average.

Within this study, for example, the inclusion of time varying school characteristics reduces the estimated “pure impact” of racial composition, indicating that school quality tends to go down with increased black concentration. Differences in quality between schools in urban centers and suburban areas also support this general concern.³⁷

The policy implications of these findings are, nonetheless, unclear, because of both the imbalance in the distribution of students across jurisdictions and the possibility that expanded exposure to nonblacks following additional desegregation activity could have a much different effect on achievement than that estimated from the current distribution of students among schools. Moreover, the *Brown* decision and subsequent refinements in the case law with additional cases sharply restrict the circumstances in which interdistrict remedies are permissible (Armor (1995)). Thus, the room for direct school policy action to alter the overall racial composition of schools is currently very limited. One possible approach might be to develop special academic schools within districts (such as magnets) that might ameliorate the negative effects of composition on higher ability black students. Nonetheless, while such policies have been pursued in a number of court-managed desegregation plans, little evidence on their effectiveness is known, and they remain limited by district boundaries. An alternative supported by a range of prior investigations would emphasize a change in focus to housing policy. Over three decades ago, Kain and Persky (1969) suggested that: “*De facto* school segregation is another widely recognized limitation of Negro opportunities resulting from housing market segregation. A large body of evidence indicates that students in ghetto schools receive an education that is much inferior to that offered elsewhere.” This led them to argue for more

³⁶ Equalizing the distribution of black students would reduce the average percentage of black classmates from 40 percent to the state percentage of blacks, 15 percent. If the impact in Table 3 (-0.22) is accumulated for the three grades, the result would be a 0.17 standard deviation improvement in scores.

³⁷ Our prior investigation of Tiebout choice of schools found that, after correcting for individual selection effects, blacks in Texas on average attend poorer schools and face much more disruption in their schools from student mobility (Hanushek, Kain, and Rivkin (2001)). While not considering racial composition explicitly, schools with higher concentrations of blacks are located most frequently in the urban centers of Texas where schools on average are lower quality.

aggressive policies promoting housing desegregation as opposed to expensive compensatory strategies that left ghettos unaffected. More recently, the outcomes of the Gautreaux Program (Rosenbaum (1995)) and the Moving to Opportunity experiments (Ludwig, Ladd, and Duncan (2001)) have reinforced the possibility of favorable outcomes from housing dispersal programs.³⁸ Policies that support the continued suburbanization of black Americans and the slow but steady decline in black-white segregation that has marked the last two decades (Cutler, Glaeser, and Vigdor (1999), Iceland and Weinberg (2002)) would, by the results of this paper, lead to improved schooling outcomes – particularly for higher achieving black students.

³⁸ Ludwig, Ladd, and Duncan (2001) find that moves to low poverty areas lead to significant increases in student achievement, but they cannot identify the source of such differences – whether school quality, peer influences, neighborhood effects, or other potential influences. Our analysis suggests that a likely component involves peer influences, since almost all participants are black.

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Appendix Table A1. Achievement Distribution for Blacks and Whites by Quartile of State Math Test Score Distribution

Quartile of Distribution of Third Grade State Scores:				All
Bottom Quartile	Second Quartile	Third Quartile	Top Quartile	

Placement in achievement distribution

Black students	41.4	30.0	19.1	9.5	100
White students	14.7	21.6	28.5	35.2	100

Appendix Table A2. Percentage of Racial and Ethnic Classmates for Black and White Students by Quartile of State Math Test Score Distribution

Quartile of Distribution of Third Grade State Scores:				All
Bottom Quartile	Second Quartile	Third Quartile	Top Quartile	

Black classmates for:

Black students	38.5	38.1	39.9	42.8	39.2
White students	9.4	9.3	9.2	9.3	9.3

Hispanic classmates for:

Black students	21.6	21.4	20.9	21.0	21.4
White students	19.3	18.4	17.6	17.3	18
