TEACHER MOBILITY, SCHOOL SEGREGATION, AND PAY-BASED POLICIES TO LEVEL THE PLAYING FIELD

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Abstract

Research has consistently shown that teacher quality is distributed very unevenly among schools, to the clear disadvantage of minority students and those from low-income families. Using North Carolina data on the length of time individual teachers remain in their schools, we examine the potential for using salary differentials to overcome this pattern. We conclude that salary differentials are a far less effective tool for retaining teachers with strong preservice qualifications than for retaining other teachers in schools with high proportions of minority students. Consequently large salary differences would be needed to level the playing field when schools are segregated. This conclusion reflects our finding that teachers with stronger qualifications are both more responsive to the racial and socioeconomic mix of a school's students and less responsive to salary than are their less-qualified counterparts when making decisions about remaining in their current school, moving to another school or district, or leaving the teaching profession.

1. INTRODUCTION

Public schools that are segregated by the race or socioeconomic status of their students raise many educational and societal concerns. Of central interest for this article is that such segregation is typically associated with an uneven distribution of resources, the most important of which is teacher quality (as measured here by teacher qualifications) across schools. Schools with large proportions of nonwhite or low-income students tend to have teachers with far weaker qualifications than those in schools serving whiter or more affluent students (Betts, Rueben, and Danenberg 2000; Lankford, Loeb, and Wyckoff 2002; Clotfelter, Ladd, and Vigdor 2006, 2007). This well-documented pattern largely reflects the operation of a teacher labor market in which the distribution of teachers across schools is determined not only by state or district policies but also by the preferences of teachers.

For the purposes of this study, we define an equitable distribution of teachers as one in which students of different racial and economic groups have equal access to teachers with strong qualifications.[1] This input-based definition of equity is far less demanding than an outcome-based equity measure, which might well require that disadvantaged groups, often challenging to teach, have access to teachers with even stronger qualifications than those available to other students (see Ladd 2008 and also Roemer 1998 in a broader policy context). Nonetheless, given the current uneven distribution of teachers in the United States, attaining a level playing field even in our more limited sense still represents a challenging equity goal.

One way to assure an equitable distribution of teachers would be for a state or district to require that students of different racial and economic groups be evenly distributed across schools. In that case, members of each student group would automatically have equal access to teachers with strong qualifications at the school level.[2] Although the school desegregation plans that were introduced starting in the late 1960s pushed many districts in that direction with respect to race, the Supreme Court's 2007 decision in *Parents Involved in Community Schools v. Seattle School District No. 1*, 551 U.S. 701, has ruled out the explicit

1. Throughout, we use the expressions "teachers with strong qualifications" or "strong teachers" rather than the more felicitous phrase "highly qualified teacher" so as not to confound our concept with that embedded in the federal No Child Left Behind legislation, which requires that all teachers be highly qualified but which in practice allows states to water down the requirement for many of their established teachers. Ideally one might prefer a more encompassing but difficult to observe construct of teacher quality. For reasons we discuss further below, we take the more pragmatic approach of focusing on teacher qualifications.
2. This even distribution of students across schools, however, would still not assure equal access to quality teachers across student groups within schools at the classroom level to the extent that classrooms are segregated. Clotfelter, Ladd, and Vigdor (2003, 2008) document for North Carolina that at the elementary level, most of the racial segregation is between, not within, schools. At the high school level, within-school segregation plays a far larger role.

use of the race of a student in assigning students to schools. The use of socioeconomic rather than racial measures for the purposes of school balance would address this legal hurdle. It would not, however, address the political challenge posed by middle-class parents who tend to be highly protective of their middle-class schools and strongly resistant to efforts to move their children to schools with many minority or low-income students.[3]

In light of these obstacles, an alternative approach for promoting an equitable distribution of teachers would be for states or districts to pursue strategies designed to counter what many teachers may view as the difficult working conditions associated with large proportions of educationally disadvantaged students. Policy makers could, for example, invest in other components of the working conditions in those schools, such as school safety or the quality of school leadership (Milanowski et al. 2009; Ladd forthcoming). Another strategy, and the one of central interest for this study, is for policy makers to use salary differentials to help schools serving disadvantaged students attract and retain teachers with strong qualifications. The success of such a strategy depends largely on how responsive teachers are to salary differentials on the one hand and to school demographic characteristics on the other as they make their job market decisions.

We use longitudinal data for teachers in North Carolina to examine these responses, with particular attention to the differential responses of teachers with strong qualifications compared to those with average qualifications. Specifically, we estimate probit models to examine how salary affects the ability of schools to fill vacancies with strong teachers, and we estimate competing risk hazard models to determine how both salary and school demographics affect teachers' decisions to leave their current schools. The results permit us to estimate the magnitudes of the salary differentials that would be required to offset specified differences in segregation across schools.

As discussed below, this research follows in a long tradition of studies that examine the determinants of teacher mobility. The research reported here is enriched by the following components. First is our explicit attention to whether teachers with strong qualifications respond more or less strongly than other teachers to salary incentives and to the demographic characteristics of schools. Second is our detailed modeling of salary differentials that take account of the local nature of many teacher labor markets. Third is our examination of teacher movement at all three levels of schooling. Fourth is our ability to supplement

3. A clear example emerges in Wake County, North Carolina, which until recently served as a model for socioeconomic balancing of its schools. The recent election of a new school board majority openly opposed to busing to achieve socioeconomic balance now threatens that system.

our basic analysis of responses to salary differentials with a difference-in-differences analysis of two specific policy interventions that include financial incentives. One of these is a program used in two of the state's districts designed to attract or retain teachers in hard-to-staff schools, and the other is a short-lived statewide bonus program for selected teachers at low-performing middle and high schools.

2. THE TEACHER LABOR MARKET

Like those for many occupations, the labor market for teachers in this country operates largely as a set of loosely connected regional or local labor markets. The market for teachers differs from the typical labor market, however, in a number of ways, the most important of which relates to salaries. In the typical labor market, competitive pressures would force employers offering jobs with poor working conditions to pay higher salaries than other employers to attract equally qualified workers. Public schools, by contrast, are typically bound by contracts within districts that stipulate specific salary levels for teachers with a given set of credentials. To the extent that teachers with strong qualifications prefer to teach in schools with higher-achieving, more affluent, and whiter student bodies, schools with more disadvantaged students find it difficult to attract and retain those teachers. Although not all teachers have such preferences, studies dating back to Becker (1952) indicate that many do.

The gravitation of teachers with strong qualifications away from schools serving disadvantaged students to those serving more advantaged students generates potentially large inequities across schools. This sorting process consists of three identifiable processes: *attrition* (teachers leaving the profession), *movement* (teachers changing schools, either within or across districts), and *replacement* (schools filling vacancies). Much has been written about the first two of these, and we build on that literature by estimating hazard models of teacher departures from their current schools. The third process, in which schools fill vacancies, has received comparatively little attention, but it deserves to be examined because schools are not equally successful in attracting desirable teachers. Examining these three processes elucidates not only how teacher labor markets lead to inequities in the matching of teachers to students in the public schools but also the potential for salary policies to counteract these processes.

Our study builds on a substantial empirical literature that can be summarized by two major conclusions.

1. *Teachers, like most other people, respond to financial incentives in deciding where to work*. When working conditions are controlled for, the evidence shows that teachers are attracted to positions with higher salaries and are more

inclined to leave their current post or to leave teaching altogether when alternative salaries are higher. Thus higher teacher salaries in their current positions tend to reduce attrition rates, and attrition is sensitive to wage differences between teacher and nonteacher salaries.[4] Teachers with the best prospects outside teaching are generally most likely to leave teaching. In particular, higher exit rates from the profession typically emerge for teachers with high scores on achievement tests and for math and science teachers than for other types of teachers who presumably have fewer good alternatives.[5]

2. *Teachers care about certain nonwage aspects of their jobs.* As we have already noted, social science research going back at least fifty years suggests that teachers, by and large, prefer to work in schools with students who are high achieving, affluent, and white.[6] In studies of teacher attrition, these preferences reveal themselves directly through the estimated effect of certain school characteristics, and they also show up in comparisons of the origin and destination schools between which teachers transfer. Racial composition is the school characteristic most consistently associated with teacher mobility: teachers more often leave schools with higher concentrations of nonwhite students, with a greater response among white than nonwhite teachers.[7] Particularly compelling evidence of teacher sorting by the racial

4. See, for example, Murnane and Olsen 1989, 1990; Mont and Rees 1996; Podgursky, Monroe, and Watson 2004; Krieg 2006; and Reed, Rueben, and Barbour 2006. For the effect of nonteacher salaries, see Baugh and Stone 1982; Rickman and Parker 1990; and Dolton and van der Klaauw 1995. Gritz and Theobald (1996) and Imazeki (2005) incorporate teacher salaries in both the current and alternative districts, as well as nonteacher salaries. The former study finds significant effects in most specifications for nonteacher salaries. The latter includes both current and expected teacher salaries in a teacher's own district and neighboring ones, as well as average nonteaching salaries in the local area. It finds significant wage effects for current and expected teacher salaries and relative teacher salaries for women, but no effects for men or women associated with nonteaching salaries.
5. See Murnane and Olsen 1990; Lankford, Loeb, and Wyckoff 2002; and Podgursky, Monroe, and Watson 2004. Stinebrickner (1998) finds that teachers with bachelor's degrees in science were more likely to quit, and Imazeki (2005) observes higher transfer rates among women teaching math and special education. In contrast, Krieg (2006) finds that highly effective female teachers, as measured by a long history of raising test scores, were less likely to quit.
6. Hollingshead (1949, p. 171) reported, "Because the academic teachers believe that college preparatory students have more ability, are more interested, and do better work than those in the general course, they prefer to teach the former group." See also Becker 1952.
7. Greenberg and McCall (1974, table 3) show that teachers who changed schools within the San Diego school district generally ended up in a school with a smaller proportion of minority students. Lankford, Loeb, and Wyckoff (2002, table 10) for New York and Hanushek, Kain, and Rivkin (2004, table 4) for Texas show that this was also true for moves between districts. Likewise, Hanushek, Kain, and Rivkin (2004) and Falch and Strom (2005) find that higher concentrations of minority students were associated with higher rates of attrition. Scafidi, Sjoquist, and Stinebrickner (2007) find both transfers and exits to be higher from predominantly black schools in Georgia for nonblack teachers. In her study of Wisconsin teachers, Imazeki (2005) finds this aversion only for exits from teaching, and then only by white male teachers. Boyd et al. (2005) find that white and Hispanic teachers were more likely to quit or transfer from New York City elementary schools with lower proportions of white students.

mix of a school's students emerges from a recent study of how teachers responded to the resegregation of schools associated with the end of student busing in Charlotte, North Carolina (Jackson 2009).

Evidence also supports the view that teachers prefer to teach high-achieving students.[8] Feng and Sass (2008) find that effective teachers, as measured by a history of raising students' test scores, are more likely to leave schools where other teachers are generally less effective. Less strong is the evidence for reluctance to teach low-income students. Although comparisons of origin and destination schools show that teachers tend to move to schools with students from more affluent families, the independent effect of income is often not confirmed statistically in equations that also include the racial mix of a school's students.[9]

An obvious policy response to these two stylized facts would be to use salary differentials to offset the effect of racial composition, or other student characteristics, on the perceived desirability of schools as workplaces. Compensation policy, however, may or may not be a practical tool for equalizing teacher quality across schools. For one thing, teachers may differ in their sensitivity to working conditions and salary. To the extent that teachers with strong qualifications are less responsive to salary and more responsive to student demographics than other teachers, for example, salary differentials might reduce the overall rate of turnover at disadvantaged schools but do little to equalize the proportion of high-quality teachers across schools. For another, salary differentials may be more powerful tools for reducing exits from the teaching profession than for altering the distribution of teachers across workplaces. Hence the power of salary differentials to promote an equitable distribution of teachers is an empirical question.

8. In comparisons of origin and destination schools, Greenberg and McCall (1974, table 3) and Hanushek, Kain, and Rivkin (2004) show that teachers moved from less to more able student bodies, as measured by average standardized test scores. Evidence of this preference also appears in two multivariate studies of attrition—Mont and Rees 1996 and, for female teachers only, Krieg 2006. Clotfelter et al. (2004) find that the rate of exit from low-performing schools increased with the advent of North Carolina's assessment program, one that exposed teachers in low-rated schools to fewer rewards and the prospect of punitive policies. Using data for New York City, Boyd et al. (2008) find that teachers in low-performing schools were more likely to leave than those in other schools.
9. See Greenberg and McCall 1974 (table 3) and Hanushek, Kain, and Rivkin 2004 (table 4). In particular, hazard models estimated by Imazeki (2005) and Krieg (2006) obtain statistically insignificant coefficients for percent of students receiving free lunch, and Reed, Rueben, and Barbour (2006) obtain a negative coefficient. Note that these insignificant coefficients are not inconsistent with the observation that teachers tend to move from poorer to richer schools because of the typically high correlation between poverty and minority enrollment. There is also evidence that teachers are more likely to quit when their classes are large (Mont and Rees 1996) or when they do not feel successful or supported by school administrators (Johnson and Birkeland 2003).

3. MAIN CONSTRUCTS AND BASIC EMPIRICAL PATTERNS

We use North Carolina data to examine teacher mobility over the period 1995–2004, with attention to all three levels of schooling. Before describing the general patterns in the data, we discuss three constructs that are central to our empirical analysis: disadvantaged students, qualifications of teachers, and teacher pay, with attention to what they mean in North Carolina, a state with more than 9 million people and diverse geographic areas that range from the coast through the Piedmont in the center to mountains in the west.[10]

Student Disadvantage

Throughout the analysis, we use as our two proxies of student disadvantage at the school level the percent of students who are nonwhite and the percent who are eligible for the federal free lunch program. Although not all nonwhite students are educationally disadvantaged, historical patterns of discrimination, limited family wealth or income, and the fact that some are recent immigrants put many in that category. Most of the nonwhite students in North Carolina are African American, although some are American Indian, and an increasing number are Hispanic. Eligibility for free lunch, which is limited to families with income below 130 percent of the poverty level, serves as a common, although admittedly imperfect, measure of family income.[11]

We focus on these racial and economic proxies for educational disadvantage largely because data for them are available at the school level. The reader should bear in mind, however, that they are at best proxy measures for a broader set of measures of student disadvantage that could well influence teachers' perceptions about a school's working conditions. Based on data from the 2000 census, table 1 reports correlations between various family or student characteristics across North Carolina's one hundred counties (whose boundaries are coterminous with school districts in most cases). The poverty rate for children is positively correlated with the nonwhite percent of the population, but the correlation is only 0.67 because the counties in the mountain region tend to be poor but white, while rural coastal and Piedmont areas are poor but nonwhite. Most striking are the high correlations between poverty and the nonwhite share on the one hand and the fraction of single parent households

10. See the appendix for detailed explanations of how we constructed the variables.
11. Because low-income high school students tend to be less willing to participate in the subsidized lunch program than their younger counterparts, the percentages are not directly comparable across levels of schooling (Gleason 1995). For that reason, whenever we use a single free lunch measure for all schools, we normalize it based on the means and standard deviations for each level of schooling. As a result, a 1 standard deviation difference at the elementary level represents a somewhat larger difference in the actual percentage of students on free lunch than at either the middle or the high school levels. For 2004, the means (standard deviations) in percents across schools were: elementary 45.7 (21.5); middle 41.1 (18.1); high school 29.1 (29.8).

Table 1. Correlations between Measures of Population Characteristics (Percent), North Carolina Counties

	Nonwhite (Including Hispanic)	Poor (Percent of Children in Poor Households)	Low Education (Less Than High School)	High Education (More Than College)	Single Parent with Children under Age 18
Nonwhite	1	0.67	0.28	−0.16	0.89
Poor	0.67	1	0.55	−0.47	0.64

Source: Calculated by authors based on data from the 2000 U.S. census.

on the other. With only one parent at home, and one that may well be working, children in such families are likely to receive less educational support at home than are those in more advantaged families. Thus an apparent aversion of teachers to either the racial or economic (or both) characteristics of students could in fact represent an aversion to other characteristics of the students that are correlated with the ones we measure.[12]

Qualifications of Teachers

We use four measurable qualifications of teachers as proxies for teacher quality. The first two are preservice qualifications: teachers' average licensure test scores and whether they graduated from a very competitive undergraduate institution. The other two are their years of teaching experience and whether they are certified by the National Board. All four have been shown to be predictive of student achievement in North Carolina and elsewhere.

Studies confirm, for example, that teachers' own ability or achievement, as measured by some form of test score, whether an SAT, ACT, or teacher licensure score, is predictive of student achievement. Indeed, teachers' test scores are the credential that most consistently emerges as predictive of student achievement across studies of various types (see summary in Goldhaber 2008). The research is somewhat less clear about the predictive power of the quality of a teacher's undergraduate institution, as typically measured by *Barron's* college ratings. Our own research using North Carolina data confirms its predictive power at the high school level but not at the elementary level (Clotfelter, Ladd, and Vigdor 2006, 2007, 2010).

12. Because disadvantaged students tend to achieve at below-average levels, it could also represent an aversion to teaching low-performing students. We have chosen not to include student achievement as a separate measure of disadvantage because it is partly endogenously determined by the quality of teachers in the schools. In addition, the racial and economic mix of students in a school may also be correlated with other working conditions valued by teachers. Research has shown, however, that the racial characteristics of schools still emerge as significant predictors of teacher movement, even in models that control for a variety of other working conditions, such as the quality of leadership, school safety, and resources as perceived by teachers (Ladd forthcoming).

With respect to years of experience, studies from a number of states consistently show that, regardless of how effective they may eventually become, teachers with no or very limited experience are far less effective at raising student achievement than teachers with more experience (see summary in Goldhaber 2008). Although the studies differ on the patterns beyond the first few years of experience, it seems safe to conclude that on average, teachers with three or more years of experience are more effective than those with less experience. In addition, most careful studies, including several based on North Carolina data, show that National Board–certified teachers are more effective at raising student achievement than are those who are not certified (Goldhaber and Anthony 2007; Clotfelter, Ladd, and Vigdor 2006, 2007, 2010). Only at the high school level, however, does it appear that the process of certification itself makes teachers more effective (Clotfelter, Ladd, and Vigdor 2010).

How we use these measures will become clear in the analysis below. Suffice it to say at this point that for some of the analysis we treat the preservice qualifications differently than those related to subsequent employment so as not to confound decisions made by teachers after they enter the profession with more exogenous measures of teacher qualifications. Not included in this list of qualifications is whether a teacher has a master's or other advanced degree, because such credentials do not generally emerge as predictive of student achievement.[13]

One might legitimately ask why we use teacher qualifications as proxies for teacher effectiveness, rather than (as is the case in some other recent studies) a more direct value-added measure based on gains in their students' test scores (e.g., Hanushek et al. 2005; Goldhaber, Gross, and Player 2009). The question is valid because variation in these four teacher qualifications explains at best only a portion of the total variation in teacher quality as measured by gains in student test scores (Goldhaber 2008). One answer is that the instability of the value-added measures for individual teachers from year to year raises questions about their reliability (Koedel and Betts 2007; Lockwood, McCaffrey, and Sass 2008). Another is that such measures can be estimated only for teachers in grades or courses that are tested annually, which in the North Carolina context would typically restrict the analysis to elementary schoolteachers of math and reading. Finally, they are not well suited for teachers with little or

13. Our own research from North Carolina shows, for example, that elementary schoolteachers who obtain a master's degree between one and five years into teaching are less effective on average than other teachers (Clotfelter, Ladd, and Vigdor 2007). Presumably this pattern says more about who decides to get a master's degree once they start teaching than about the value of the degree itself. As might be expected, at the high school level where subject knowledge matters more, master's degrees are somewhat more positively predictive of student achievement than at the elementary level, but even here the effects are very small (Clotfelter, Ladd, and Vigdor 2010).

no experience. Given our interest in the movements of all teachers who start teaching stints within a nine-year period at all levels of schooling, we have chosen to rely on teacher qualifications that we can observe for most of them.

Teacher Pay

In contrast to many other states, North Carolina is quite centralized, and teacher associations have no collective bargaining powers. The state government provides more than 60 percent of the operating funding for the state's schools, and there is a statewide salary schedule for teachers. Variation across districts comes from the fact that districts can, and typically do, supplement teacher salaries with local tax revenues. Using information on the total amount of supplements in each district and, whenever available, more detailed information on how they were distributed among teachers, we constructed salaries for different types of teachers in each district for each year of our analysis.[14] In 2004–5, the average local supplement across the state was about $2,500, with supplements in the two biggest districts of Charlotte and Wake close to $5,000 and the average in the rural areas of the state about $1,500.[15] In our models of teacher movement, the salary for a particular teacher, specified in logarithmic form, represents her salary in her current district. As we highlight below in the context of the results, our use of observational data for salaries generates downward-biased estimates of their effects on teacher mobility.[16]

Although some districts, particularly the state's large and fast-growing urban districts, operate in a state and national labor market for teachers, the relevant labor market for many districts is quite local. In particular, when existing teachers are making their decisions about remaining in or leaving their current school, the most relevant alternative salaries are those for jobs, both teaching and nonteaching, within commuting distance. We measure the alternative teaching salary available to a teacher in each district as a weighted average of the salaries of teachers with similar characteristics in the districts within a thirty-mile radius, with the weights being student enrollment in each

14. In general information is available only on the total supplemental payments and the number of recipients. For some districts, more detail is available on the Internet about how the supplements are distributed among teachers. In other cases, we had to make reasonable assumptions about its distribution. Details are provided in the appendix.
15. The evidence suggests that some of this variation is attributable to differences in the cost of living and to salary supplements that are higher in districts with higher proportions of novice teachers, presumably used to recruit more teachers. This statement is based on Walden and Sogutlu 2001 and on our own unpublished estimates for a more recent year. We control for some of these compensating differentials in our various models by including regional fixed effects.
16. Compared with many other states, the cross-district variation in teacher salaries is small. In 2004, for example, the standard deviation in salaries for teachers with a bachelor of arts degree and two years of experience across the teachers in our sample was about $800, or about 3 percent of the average salary of $27,000.

district. We measure nonteaching salaries as the employment-weighted average of salaries in all counties within a thirty-mile radius of the school district of the teacher in question. We also include a measure of the unemployment rate within the same area to capture information about the availability of jobs.

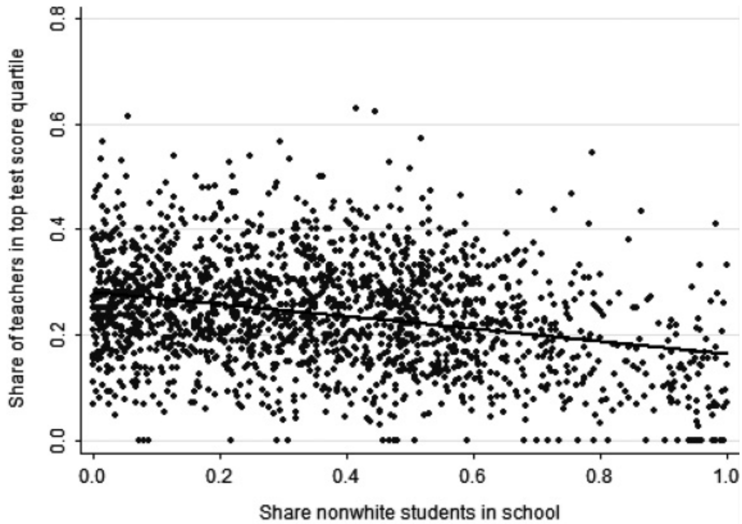
Finally, we incorporate indicator variables into our models to represent salary-related incentive programs specifically designed to attract and retain teachers in hard-to-staff schools. These programs include the Equity Plus programs used in two of the state's largest districts (Charlotte-Mecklenburg and Winston-Salem) as well as a statewide bonus program that operated between 2002 and 2004. The Equity Plus programs give certain schools a variety of benefits, including additional pay for some or all of their teachers.[17] The statewide bonus program, which we have described and analyzed in more detail elsewhere (Clotfelter, Ladd, and Vigdor 2008), provided $1,800 bonuses for certified math, science, and special education teachers to teach in disadvantaged middle schools and low-performing high schools throughout the state.

Basic Patterns

The basic empirical patterns in North Carolina are consistent with the view that teachers are inequitably distributed across schools. Figure 1 documents, for example, the relationship between one measure of teacher quality—the fraction of teachers whose certification test scores fall in the top quartile of the test score distribution—and each of the two measures of disadvantage. Although the top graph is based on all three levels of schooling, the bottom one refers to elementary schools alone because of the limitations of that measure for older students. Schools that have higher proportions of nonwhite students or higher proportions of students receiving free lunches tend to have smaller proportions of teachers with strong qualifications by this measure, a pattern that we also document in prior research (Clotfelter, Ladd, and Vigdor 2005; Clotfelter et al. 2007).

Also consistent with the literature that attributes some of this inequity to differential attrition rates by school are the patterns in figure 2. The figure depicts, by the percentage of nonwhite students in the school, the proportions of teachers who had started a job in the 1994–95 school year and had left the school by 2002–3. The two lines distinguish between teachers with

17. The program in Charlotte-Mecklenburg began in 1997–98 and has undergone several name changes since then. The program gives signing bonuses to teachers going to a designated school, and experienced "master teachers" can receive up to $2,500 for teaching in such a school. The program in Winston-Salem/Forsyth began in 1999–2000. Equity Plus schools in that district are determined by the percentage of students receiving free and reduced price lunches. All teachers in the designated schools receive bonus pay equal to 20 percent of the local supplement. This bonus increases with degree and experience, typically ranges from $500 to $1,500 per teacher, and is paid annually.



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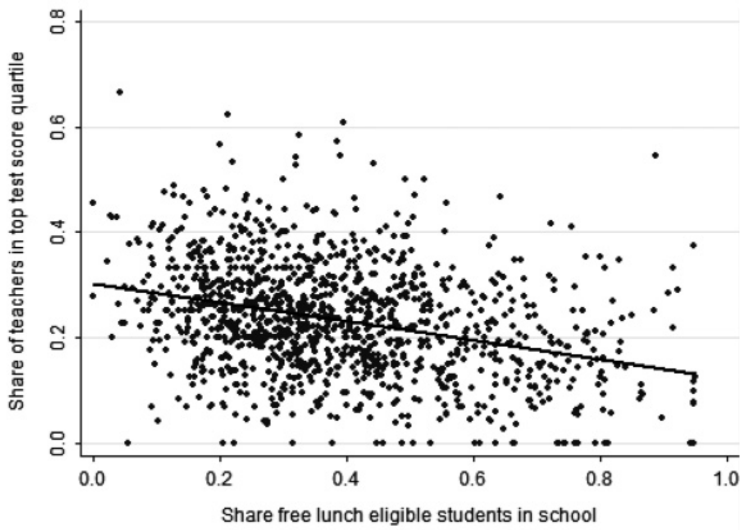

Figure 1. Share of Teachers in Top Quartile of Test Scores by Percentages of Disadvantaged Students at the School Level, 1994–95

high test scores and those with average test scores.[18] For schools serving predominantly white populations (low percentages of nonwhite students), the nine-year attrition rates for teachers hover around 60 percent and appear to be nearly independent of a teacher's licensure test score. In schools serving

18. To enhance the readability of the figure, we have collapsed schools into bins of width 0.01 (based on the school percent nonwhite). Thus the points represent groups of schools with very similar percentages of nonwhite students, not individual schools.

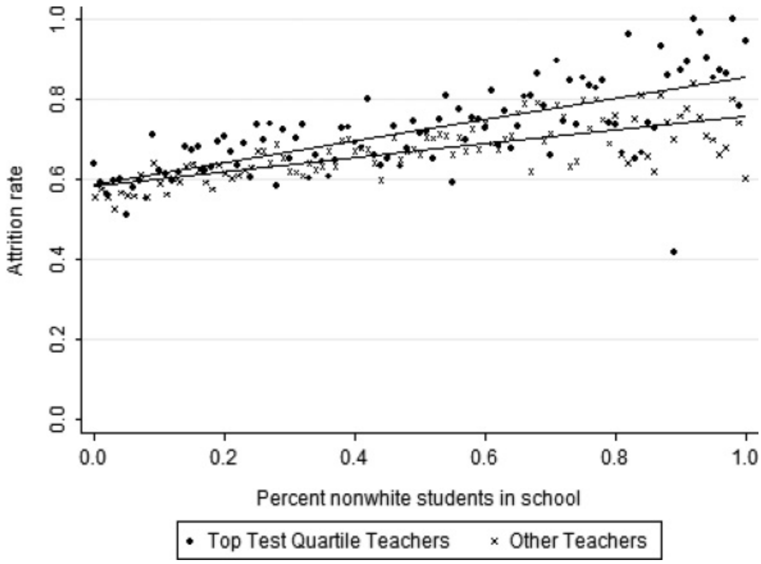

Figure 2. Teacher Attrition Rates and Percent Nonwhite Students by All Schools for Top Test Quartile Teachers and Other Teachers, 1994–95 to 2002–3. (Schools are grouped into bins of width 0.01 in terms of the percent nonwhite students in the school.)

overwhelmingly nonwhite student populations, attrition rates are higher overall and show a more distinct discrepancy between teachers with test scores in the highest quartile and all others. At schools where the nonwhite proportion of students exceeds 80 percent, the attrition rates over the period for top quartile teachers are usually above 80 percent, while those for teachers with lower certification test scores generally fall in the 60–80 percent range.

4. THE REPLACEMENT PROCESS: FILLING VACANCIES

Starting from an uneven distribution of teachers across schools, the quickest way to level the playing field would be for the schools serving disadvantaged students to fill vacancies with applicants having strong qualifications. The question of interest here is the extent to which salary might be used as a draw for such teachers. To that end, we report in table 2 four probit models of the propensity that a school will fill an open position with an applicant having each of the four qualifications predictive of higher achievement discussed above: high test scores (in the top quartile), a degree from a very competitive college, more than two years of teaching experience, and National Board certification. We note that teachers with the first two types of qualifications include both those with and without experience. In contrast, those in the other two categories include no novice teachers, with virtually all the National Board–certified teachers (NBCTs) having several years of experience, as is consistent with the

Table 2. Filling Vacancies, Probit Models, 1995–96 to 2003–4

	(1) High Test Score	(2) Very Competitive Undergraduate	(3) Experienced	(4) National Board Certification
School Characteristics				
Middle school	0.0270	0.0859***	−0.0252	−0.1020
	(0.0222)	(0.0220)	(0.0188)	(0.0553)
High school	0.0492*	0.2265***	−0.0007	−0.1053*
	(0.0198)	(0.0195)	(0.0165)	(0.0467)
Free lunch, elementary (%)	−0.0005	−0.0005	0.0000	−0.0017
	(0.0004)	(0.0004)	(0.0003)	(0.0010)
Free lunch, middle (%)	−0.0016**	−0.0010	−0.0013**	−0.0016
	(0.0006)	(0.0006)	(0.0005)	(0.0015)
Free lunch, high school (%)	−0.0006	−0.0025***	−0.0002	−0.0053**
	(0.0006)	(0.0006)	(0.0005)	(0.0019)
Nonwhite, K–12 (%)	−0.0021***	−0.0015***	−0.0019***	−0.0028**
	(0.0004)	(0.0004)	(0.0003)	(0.0009)
Building age	−0.0001	−0.0006*	−0.0011***	−0.0024***
	(0.0002)	(0.0002)	(0.0002)	(0.0006)
District Characteristics				
Free lunch (%)	0.0012	0.0025**	0.0004	0.0047**
	(0.0008)	(0.0008)	(0.0006)	(0.0016)
Nonwhite (%)	−0.0040***	0.0001	−0.0014**	−0.0055**
	(0.0007)	(0.0007)	(0.0005)	(0.0017)
Salary: Bachelor's degree plus 2 (ln)	2.3013***	4.6181***	1.7777***	2.7870***
	(0.3125)	(0.3052)	(0.2571)	(0.7485)
Alt. salary (ln)	0.6725**	2.2526***	0.2701	0.6497
	(0.2254)	(0.2311)	(0.1869)	(0.5531)
Unemployment rate	−0.0208***	−0.0325***	0.0043	0.0099
	(0.0045)	(0.0047)	(0.0037)	(0.0116)
Equity Plus (EP) Incentive Programs				
CM EP school	−0.0344	0.0040	−0.0032	0.0526
	(0.0360)	(0.0348)	(0.0311)	(0.0913)
CM ever EP	−0.0450	−0.1118***	−0.1058***	0.0757
	(0.0304)	(0.0295)	(0.0258)	(0.0774)
WS EP school	−0.0527	−0.1231	−0.0788	−0.4276
	(0.0766)	(0.0753)	(0.0626)	(0.2408)
WS ever EP	−0.0369	−0.0475	−0.0946*	−0.0886
	(0.0484)	(0.0472)	(0.0413)	(0.1649)
N	129,388	129,388	129,388	129,388

Notes: Controls: Log enroll (dist), rural, coastal, mountain, beach, years, indicator for no district within in 30 miles. Union schools in 2003 were excluded due to missing data. Standard errors are in parentheses. CM = Charlotte-Mecklenburg; WS = Winston-Salem.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

requirements of that qualification. All the models were estimated based on data from 1995–96 to 2003–4 and include the variables listed in table 2 as well as others listed in the table footnote. (See appendix table A.1 for means and standard deviations.) The unit of observation is a school vacancy that is filled with a replacement teacher by year.[19]

Because probit coefficients are not straightforward to interpret, we begin by focusing on their signs and statistical significance, and leave to a subsequent table the policy implications of the estimated magnitudes. Emerging most clearly and consistently across all five equations are the statistically significant negative coefficients on the nonwhite percentage of the school's students, the relatively consistent negative coefficients on the nonwhite percentage in the district, and the statistically significant positive coefficients on district salary (expressed in logarithmic form).[20] These patterns imply, as expected, that the higher the nonwhite share of students in the school or the district, the harder it is for the school to fill a vacancy with a teacher having any of the specified qualifications. However, these patterns also imply that higher salaries make it easier to do so.

Results for many of the other variables are more mixed across the equations. Compared with elementary schools, for example, middle schools and high schools find it easier to fill vacancies with teachers having degrees from a very competitive college and possibly with high test scores. Consistent with the racial patterns for those two levels of schooling, the coefficients of the proportion of students eligible for free lunch are negative in all cases but are not always statistically significant. We also included a variable denoting the age of the building with the expectation that older schools might find it more difficult to attract teachers than newer ones with more modern amenities. As expected, the evidence is generally consistent with that expectation.

Among the district-level variables, most intriguing are the results for the salaries in nearby districts and the local unemployment rate. The somewhat unexpected positive sign in the first two columns for the nearby teacher salaries (alt. salary) suggests that, holding constant the salary in the specific district, teachers with strong preservice qualifications are more attracted to schools in districts located near high-paying districts than to those in districts in geographic areas with lower salaries. Our interpretation is that for some teachers

19. All the models presented here pool the three levels of schooling. We have also estimated separate models by level of schooling. The patterns do not differ much by level of schooling. Where differences emerge, we highlight them in a later footnote. In addition, we have estimated a model that examines the probability of hiring a teacher with a combination of all the strong qualifications or three of the four qualifications, but the probabilities of those combinations are too low in many cases to make the results meaningful.

20. The district salary is for a teacher with a bachelor's degree and two years of experience.

the initial district may be the first step toward obtaining a job in the higher-paying district. The negative coefficient on the unemployment rate in those same two columns is consistent with that general story: a higher overall unemployment rate in the local area makes it more difficult for a school to attract a teacher with either of the strong preservice qualifications. These patterns differ from those for the chances of hiring the more experienced teachers, as shown in the final two columns. Presumably because many teachers with experience or who are board certified are already in the area, neither the alternative salary nor the unemployment rate has a statistically significant effect on the chances that such teachers will be hired.[21]

To infer the impact of the Equity Plus programs in the Charlotte-Mecklenburg (CM) and Winston-Salem (WS) districts, we introduce two sets of indicator variables. Each set includes a variable designating whether the school was eligible for the program in the current year (EP school) and whether the school ever participated in the program (ever EP), which controls for any permanent unobserved difference between participating and other schools. Thus the coefficient of the "EP school" variable generates our best estimate of the treatment effect of the program. The results in table 2 show no evidence that participation in either district's Equity Plus program in a particular year increased the probability that schools would recruit more teachers with strong qualifications. Although the generally negative coefficients on the "ever EP" indicators show, as expected, the greater challenges such schools face in hiring teachers with strong qualifications, none of the program-specific coefficients are statistically significant. We do not find the absence of a recruiting effect surprising, given that many prospective teachers may not expect the bonus program to be sustained over time.

Table 3 spells out the salary implications of the key coefficients related to the school and district characteristics from the top two panels of table 2. The entries in each cell are the salary differences required to level the playing field between schools with the specified differences in nonwhite shares of students in the school (panel A) and in the district (panel B). For example, panel A indicates that to neutralize a difference in the nonwhite school percentage of 50 percentage points (e.g., between schools with 25 and 75 percent nonwhite shares) on the probability of hiring a teacher with a high test score, the salary would have to be 4.7 percent higher in the more nonwhite school, controlling for the district-level share. Further, the required salary needed to offset a 50

21. We have not included nonteaching salaries in this equation because the variable was missing for some of our districts in some years. In samples restricted to the districts for which we had complete data, its coefficient is only marginally significant in one model, that for hiring a teacher from a selective college, where it is negative.

Table 3. Salary Differences Required to Level the Playing Field (Percent)

Panel A	**Percentage Point Difference in Nonwhite Share in School**				
	10	*20*	*30*	*40*	*50*
High test score	0.9	1.8	2.8	3.7	4.7
Undergrad very competitive	0.3	0.7	1.0	1.3	1.6
Experienced	1.1	2.2	3.3	4.4	5.5
NBCT teacher	1.0	2.0	3.1	4.1	5.2
Panel B	**Percentage Point Difference in Nonwhite Share in District**				
	10	*20*	*30*	*40*	*50*
High test score	1.8	3.5	5.4	7.2	9.1
Undergrad very competitive	0.0	0.0	0.1	0.1	0.1
Experienced	0.8	1.6	2.4	3.2	4.0
NBCT teacher	2.0	4.0	6.1	8.2	10.4

percent difference in both the school and the district percentage of nonwhite students on the probability of hiring a teacher with a high test score would be the sum of the relevant entries in the two panels, or 13.8 percent. On a base salary of, say, $30,000, the required differential would amount to $4,100.[22]

Four observations are worth making about these entries. First, given that the required salary differentials are estimated from existing salary differentials across districts, they should be interpreted as persistent salary differences rather than as differences in the form of bonuses that apply to either a single year or a short period, as might be the case for the Equity Plus programs. The second is that we are less confident about the exact numbers for required salary differentials that are large relative to the actual variation in our sample than we are for relatively small implied salary differentials, such as those in the range of 6–8 percent.[23] Nonetheless, we can be quite confident that they are big. The third is that the entries should be interpreted as upper bound estimates of the required salary differentials, because the estimated coefficients of the salary variables most likely underestimate the effect of salary on hiring decisions. That is the case because some of the interdistrict salary differences undoubtedly reflect compensating differentials for district characteristics not fully controlled for in the models, including, for example, differences in the

22. Separate estimates by level of school imply that the salary differentials would have to be highest at the high school level and lowest at the elementary level. Note in addition that it would not be correct simply to add the relevant coefficients to determine the required salary differential needed to hire a teacher with more than one of the specified qualifications because of the potential for positive correlation among them.
23. Within our sample, a 1 standard deviation in salary in any one year is about 3 percent.

cost of living. If the downward bias were as large as 25 percent, for example, unbiased estimates of the required differentials would be 25 percent smaller than those reported in table 3.[24] Third, even with the downward adjustments of this magnitude, the entries suggest that salary differentials are potentially powerful tools for equalizing the ability of schools to fill vacancies with strong teachers. At the same time, the salary differentials required to neutralize the effects of large differences in concentrations of student disadvantage are likely to be far higher than the $1,800 bonus that the state legislature embedded in its short-lived Bonus Program.

5. ATTRITION AND MOVEMENT

Once hired to work in a school, a teacher can leave the school by one of three routes: she can leave the teaching profession, transfer to another school within the same district, or move to another district. Because of the nature of our data, we cannot separate those teachers who leave the profession from those who move to another state, into the private sector, or into a charter school. Hence, for this analysis, the option labeled "leaving teaching" in fact means leaving the traditional North Carolina public school system.

As in the previous section, our goal is to identify the role of student demographics and specific policy levers, most notably salary, in predicting these three types of teacher moves so that we can assess the viability of compensatory policies to equalize rates of departure, with particular attention to the moves of teachers with strong qualifications. Our models include a number of teacher-level, school-level, district-level, and local area-level covariates, as well as indicator variables by year. These covariates capture both the personal predictors of departure, such as being a female of childbearing age, and the local amenities or opportunity costs that might influence teacher decisions.

We model teacher choices using a discrete time, competing risk hazard model, where the hazard rate λ_i (t_j) is the probability that a teaching spell will end at the close of year t_j by way of exit mode i, conditional on the teacher not having left his or her school before this period. In order to avoid the complications of dealing with left-censored observations, we restrict our analysis to teachers who began teaching spells during the period under study—that is, between 1994–95 and 2003–4. We separately analyzed two sets of teachers, those who had never taught before the new spell began (initial teaching spell) and those who had previously taught before the spell began (second or later teaching spell). We adopt the Cox proportional hazard model, a semi-parametric

24. We use the 25 percent figure because that is the degree of estimated bias reported in Hanushek, Kain, and Rivkin 2004.

specification that is agnostic with respect to the form of the baseline hazard function,[25] and estimate a system of equations of the form:

$$\lambda_{i(t_j)} = \lambda_{oi}(t_j)\exp(X\beta_i + \mu_i),$$

where λ_i (t_j) is the hazard rate applying to exit mode i, λ_{oi} (t_j) is the baseline hazard, X is a matrix of teacher, school, district, and region characteristics relevant to movement or attrition for teachers in the sample, μ_i is an error term, and β_i is a vector of coefficients. For 0–1 dichotomous variables, the hazard ratio relevant to exit mode i—the estimated multiplicative impact of a unit change on the conditional probability of a spell ending at the close of year t_j, given that the teacher has remained in the original school up to that point—is calculated as $\exp(\beta_i)$. Consistent with the proportional hazard model, the impact of these covariates is assumed to be independent of the duration of the teaching spell.

Over the period of study, we observed 48,753 teachers in their first spell and 27,928 teachers in a later spell, some of whom overlap with the first group. For the former teachers, we allow their first spells of teaching in the same school to last for up to nine years, which generates a sample of 121,547 teacher-year observations. Based on all our observations of these teachers over the sample period, the probability that a teacher in her first spell of teaching would leave the state's public schools in any given year is 9.4 percent. The corresponding probability of leaving the district for another district in the state is 6.9 percent, and the probability of switching schools within a district is 14.2 percent. For the 27,928 veterans, we follow each new spell that started during the period 1995–96 to 2003–4, which generates a sample of 99,754 teacher-year observations.[26] The corresponding departure probabilities for this group are 13.5 percent for leaving the profession, 4.8 percent for leaving the district, and 10.6 percent for leaving the school for another school within the district.

Full results for our panel of teachers in their first spells are reported in table 4 and in subsequent spells in table 5. The entries are reported as hazard ratios, with ratios greater than one indicating that a factor makes departure via a particular route more likely and below one less likely. In addition to the variables of interest, we have also included indicators for the gender and race of each teacher and a set of indicator variables for the age of the teachers,

25. In particular, the proportional hazard specification accommodates either positive or negative duration dependence. That is, the period a teacher has been in her current position could be either positively or negatively associated with the probability that she would leave the school in the next period.
26. There is one less year for the veteran teachers because we had to use the 1994–95 information to determine whether the teacher was starting a new spell in the subsequent year.

Table 4. Teacher Departures, by Exit Route, for Initial Teaching Spells (Hazard Ratios)

		Exit Route		
Variable	**All Exit Routes**	**Leave Teaching**	**Switch Districts**	**Change Schools**
Teacher Characteristics				
Female	0.957**	0.884***	1.061*	0.968
Black	1.070***	1.228***	0.795***	1.066**
Other nonwhite	1.008	1.069	0.720***	1.125*
Teacher age 25–29	0.936***	0.973	0.837***	0.926
Teacher age 30–34	0.947	0.952	0.838*	0.991
Teacher age 35–39	0.948	0.967	0.839	0.965
Teacher age 40–44	0.946	0.996	0.784	0.936
Teacher age 45–49	0.898	0.792**	0.872	1.126
Teacher age 50 and over	1.057	1.013	1.018	1.093
Teacher age 25–29 * female (teacher)	1.097***	1.194***	1.041	1.038
Teacher age 30–34 * female (teacher)	1.034	1.106	0.887	1.060
Teacher age 35–39 * female (teacher)	0.970	0.960	0.854	1.154
Teacher age 40–44 * female (teacher)	0.902	0.818*	0.651**	1.324*
Teacher age 45–49 * female (teacher)	0.957	0.990	0.793	1.056
Teacher age 50 and over * female (teacher)	0.991	1.017	0.780	1.242
Teacher Qualifications				
Teacher test score—highest quartile	1.025*	1.152***	0.978	0.897***
Undergrad college very competitive	1.037***	1.092***	1.043	0.935***
National Board certified	0.872**	0.522***	1.172	1.089
Has advanced degree	1.052**	1.053	1.265***	0.968
Graduated NC college	0.841***	0.599***	1.269***	1.104***
Graduated bordering state college	0.966	0.931**	0.993	1.014
Teacher test score—missing	1.376***	2.061***	0.744***	0.948*
School Characteristics				
Middle school	1.066***	1.106***	1.205***	0.955**
High school	0.998	1.224***	1.153***	0.620***
Free lunch eligible (%) (normalized)	1.030**	1.023	0.994	1.064***
Nonwhite students (%) (demeaned)	1.002***	1.002***	1.006***	1.000
Age of school building	1.000	1.000	1.000	1.002***
Building age missing	0.985	0.989	0.991	0.967
District Characteristics				
Free lunch eligible (%) (demeaned)	1.000	1.001	0.999	0.999
Nonwhite students (%) (demeaned)	1.001	1.002**	1.000	0.998
Enrollment (ln)	0.987	0.995	0.784***	1.188***
Growth rate	1.460	1.844	0.149*	2.066
Rural	1.009	0.968	1.002	1.108***
Coastal	0.961*	0.952	1.084**	0.889***

Table 4. Continued.

Variable	All Exit Routes	Exit Route: Leave Teaching	Switch Districts	Change Schools
Mountain	0.983	0.957	1.023	0.973
Research university or college in county	1.017	1.026	0.956	1.069**
Beach county	1.066**	1.180***	0.848***	1.120**
Labor Market Characteristics				
Salary (ln) (demeaned)	0.224***	0.065***	0.158***	0.860
Teacher salary (weighted avg.) in surrounding districts (ln)	1.371	1.035	2.869**	1.675
Local area nonteaching salary (ln)	1.113**	1.012	1.836***	0.840*
Area unemployment rate	0.989**	0.982**	1.009	0.986
Equity Plus (EP) Incentive Programs†				
CM EP school	1.035	0.966	0.648***	1.053
CM ever EP	0.970	1.006	1.185	1.074
WS EP school	0.844*	0.828	0.963	1.081
WS ever EP	0.964	0.870	0.776	0.899
Interactions with Teacher Test Score in Highest Quartile				
Salary (ln) (demeaned)	1.920***	7.338***	0.752	0.737
Nonwhite students (school) (%) (demeaned)	1.003**	1.005***	0.999	1.002
Nonwhite students (district) (%) (demeaned)	0.997**	0.998	1.002	0.994**
Free lunch eligible (school) (%) (normalized)	0.972	0.889***	1.036	1.047
Free lunch eligible (district) (%) (demeaned)	1.004**	1.005*	1.001	1.002
Interactions with Very Competitive Undergraduate College				
Salary (ln) (demeaned)	1.309	0.965	1.076	2.267***
Nonwhite students (school) (%) (demeaned)	1.001	0.999	1.004	1.004**
Nonwhite students (district) (%) (demeaned)	0.998	1.002	0.989***	0.995*
Free lunch eligible (school) (%) (normalized)	0.966	0.986	0.929	0.976
Free lunch eligible (district) (%) (demeaned)	1.003	0.998	1.012***	1.002
Number of teacher-years	121,547	121,547	121,547	121,547

†CM = Charlotte-Mecklenburg; WS = Winston-Salem.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

both by themselves and interacted with whether the teacher is female. These variables control for different departure propensities by age and also among women of childbearing age. As one might expect, female teachers in their initial teaching spells in the 25–29 age range exhibit higher probabilities of leaving the profession than male teachers and teachers of other ages in any specific year, given that they have been in the school to that point. Some of them, however, may reappear as veteran teachers starting a new spell in a subsequent year. For both samples, females are less likely than males to

Table 5. Teacher Departures, by Exit Route, for Subsequent Teaching Spells (Hazard Ratios)

		Exit Route		
Variable	All Exit Routes	Leave Teaching	Switch Districts	Change Schools
Teacher Characteristics				
Female	0.894*	0.773***	0.883	1.150
Black	1.085***	1.175***	0.885***	1.074**
Other nonwhite	1.072*	0.893**	0.819**	1.453***
Teacher age 25–29	1.031	0.973	0.835	1.280**
Teacher age 30–34	0.972	0.842**	0.996	1.216*
Teacher age 35–39	0.839***	0.746***	0.804	1.045
Teacher age 40–44	0.880*	0.732***	0.929	1.144
Teacher age 45–49	0.896*	0.800**	0.906	1.079
Teacher age 50 and over	0.999	1.084	0.858	0.977
Teacher age 25–29 * female (teacher)	1.067	1.292***	1.170	0.751**
Teacher age 30–34 * female (teacher)	1.112	1.366***	0.940	0.883
Teacher age 35–39 * female (teacher)	1.161**	1.320***	0.954	1.012
Teacher age 40–44 * female (teacher)	1.044	1.118	0.936	0.924
Teacher age 45–49 * female (teacher)	0.984	0.945	0.904	0.976
Teacher age 50 and over * female (teacher)	0.973	0.928	0.919	1.050
Teacher Qualifications				
Teacher test score—highest quartile	0.994	1.082***	0.829***	0.974
Undergrad college very competitive	1.018	1.089***	0.938*	0.945**
National Board certified	0.863***	0.451***	0.925	1.315***
Has advanced degree	1.078***	1.097***	1.125***	1.031
Graduated NC college	0.874***	0.737***	0.942*	1.048**
Graduated bordering state college	0.981	1.007	0.860***	1.005
Teacher test score—missing	1.060***	1.228***	0.802***	0.995
School Characteristics				
Middle school	1.058***	1.090***	1.279***	0.945**
High school	0.946***	1.096***	1.218***	0.681***
Free lunch eligible (%) (normalized)	1.043***	1.002	1.099***	1.071***
Nonwhite students (%) (demeaned)	1.002***	1.002**	1.004***	1.001
Age of school building	1.001**	1.000	1.000	1.002***
Building age missing	1.031	0.983	1.035	1.095***
District Characteristics				
Free lunch eligible (%) (demeaned)	1.000	1.002	0.996*	1.001
Nonwhite students (%) (demeaned)	1.001	1.003**	1.002	0.997**
Enrollment (ln)	0.989	0.983	0.727***	1.189***
Growth rate	2.003	14.693***	2.067	0.020***
Rural	0.993	0.983	1.021	1.023
Coastal	0.911***	0.944	0.968	0.840***

Table 5. Continued.

Variable	All Exit Routes	Exit Route: Leave Teaching	Switch Districts	Change Schools
Mountain	0.976	1.001	1.001	0.919**
Research university or college in county	1.017	1.065**	0.983	0.991
Beach county	1.080**	1.116**	0.833**	1.175***
Labor Market Characteristics				
Salary (ln) (demeaned)	1.171*	1.172	0.737	1.199
Teacher salary (weighted avg.) in surrounding districts (ln)	0.731***	0.446***	1.551**	1.155
Local area nonteaching salary (ln)	0.971	0.687***	1.605***	1.124
Area unemployment rate	0.992	0.980**	1.023*	0.990
Equity Plus (EP) Incentive Programs†				
CM EP school	0.945	0.905	0.900	1.095
CM ever EP	1.080*	1.099	1.068	0.963
WS EP school	0.876	1.186	0.853	0.918
WS ever EP	0.853*	0.793*	0.870	0.611***
Interactions with Teacher Test Score in Highest Quartile				
Salary (ln) (demeaned)	0.975	1.266*	0.734	0.844
Nonwhite students (school) (%) (demeaned)	1.001	1.000	1.001	1.002
Nonwhite students (district) (%) (demeaned)	1.000	1.002	1.001	0.998
Free lunch eligible (school) (%) (normalized)	0.982	0.985	0.899	1.016
Free lunch eligible (district) (%) (demeaned)	1.000	0.997	1.007	1.001
Interactions with Very Competitive Undergraduate College				
Salary (ln) (demeaned)	0.933	0.857	1.168	1.087
Nonwhite students (school) (%) (demeaned)	1.001	0.999	1.002	1.004**
Nonwhite students (district) (%) (demeaned)	0.998	1.002	1.001	0.991***
Free lunch eligible (school) (%) (normalized)	1.001	0.995	1.035	1.004
Free lunch eligible (district) (%) (demeaned)	1.000	0.996	1.002	1.003
Number of teacher-years	99,754	99,754	99,754	99,754

†CM = Charlotte-Mecklenburg; WS = Winston-Salem.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

leave their current school, and black teachers are not only more likely to leave their current school but are also more likely than white teachers to leave the profession altogether.

Effects of Strong Qualifications

The various measures of teacher qualifications enter the models in different ways. One measure of quality, having some experience, is included implicitly by the estimation of separate models for initial and subsequent spells. By definition, any teacher observed in a second or subsequent spell has at least one year of experience and could well have many more. Consequently, consistent with the evidence cited earlier, such teachers are likely to be more effective than typical teachers in their first teaching spells. The two preservice qualifications variables—having a highest quartile test score and having attended a very competitive undergraduate institution—enter the model both directly as well as interacted with the salary and demographic variables, so we can test for differential responses of teachers with those qualifications.

NBCT status is included in the equations as a control variable but is not interacted with other variables because teachers can select into this qualification after they enter the teaching profession. Only those teachers who are committed to the profession are likely to undertake the rigorous process to become certified, given that the certification is not transportable to nonteaching jobs. Similarly, many teachers select into the category of having a master's degree after they enter the profession with the goal of obtaining a higher salary as a teacher. For that reason, we have included whether a teacher has an advanced degree as an additional control variable that could affect teacher mobility. Consistent with the selection processes just described, table 4 shows that teachers who are board certified exhibit lower hazards of leaving their current schools than teachers who are not board certified and that the lower hazard is attributable primarily to their greatly reduced hazard of leaving the profession. In contrast, teachers with advanced degrees emerge as more willing than comparable teachers without an advanced degree to leave their current school, but they do so primarily by changing districts. Thus their advanced degrees increase their mobility within, but not necessarily outside, the teaching profession.

The models also include as control variables whether the teacher graduated from a North Carolina college or a college from a bordering state. Graduation from a North Carolina college reduces the exit hazard for a teacher both for all types of exit and for leaving the profession, which, recall, could refer to leaving the state.

Table 6 reports the hazard ratios of the two preservice teacher qualifications separately for the two samples of teaching spells. In each case the ratios are relative to a "regular" teacher, defined as one who neither has a licensure test score in the top quartile nor attended a very competitive college. For the teachers in their initial spells, we find that the two measures of strong qualifications, both separately and combined, are associated with higher overall exit hazards, despite the fact that these teachers are less likely than regular teachers to change schools within the district. Their higher overall exit rates arise because of their far greater likelihood of leaving the profession. In particular, a teacher with both high test scores and a degree from a very competitive college is more than 25 percent more likely to end a teaching spell by leaving

Table 6. Effects of Teacher Qualifications on Teacher Exits (Hazard Ratios)

	All Exit Routes	Exit Route: Leave Teaching	Exit Route: Switch Districts	Exit Route: Change Schools
Panel A: Initial Teaching Spells				
Teacher qualifications relative to regular teacher in average school				
Has a high quartile test score	1.025*	1.152**	0.978	0.897**
Undergraduate very competitive	1.037**	1.092**	1.043	0.935**
High test + very competitive college	1.063**	1.258**	1.020	0.839**
Panel B: Subsequent Teaching Spells				
Teacher qualifications relative to regular teacher in average school				
Has a high quartile test score	0.994	1.082**	0.829**	0.974
Undergraduate very competitive	1.018	1.089**	0.938*	0.945**
High test + very competitive college	1.012	1.179**	0.778**	0.920**

*statistically significant at the .10 level; **statistically significant at the .05 level.

the profession than is a regular teacher. For the teachers in their second or later teaching spells, in contrast, the overall exit hazards for teachers with this combination of strong qualifications of leaving their current school are not statistically different from those of a regular teacher. These overall exit ratios, however, mask differential exit routes of the teachers with strong qualifications. Although such teachers are about 8 percent less likely than other teachers to end a teaching spell by moving to a different school within the same district and about 22 percent less likely to change districts, they are about 18 percent more likely to end it by leaving the profession.

Responses to Own Salary and School Demographics

The entries in table 7 illustrate how exit hazards are affected by salaries and by the demographic characteristics of the teachers' schools, with particular attention to the different response rates of regular teachers and teachers with strong qualifications. In all cases, the salary change refers to the teacher's salary in her current district, assuming no change in teaching or nonteaching salaries in the local area. Of most interest are the findings for the teachers in their initial spells as reported in the first panel.

Consider first the simulated hazard ratios for a regular teacher of leaving her current school by any of the three exit routes. A 10 percent increase in salary reduces the probability that she will leave her current school in any given year by about 14 percent (one minus the hazard ratio of 0.861). In contrast, a 10 percentage point increase in the nonwhite students in the school increases the probability by about 2 percent, and a 1 standard deviation

Table 7. Responses to Salary and School Demographics, by Type of Teacher (Hazard Ratios)

		Exit Route		
	All Exit Routes	**Leave Teaching**	**Switch Districts**	**Change Schools**
Panel A: Initial Spells				
Predicted response to a 10 percent increase in district salary (in average school)				
Regular teacher	0.861**	0.761**	0.831**	0.985
Regular teacher plus 2 qualifications	0.944*,++	0.925*,++	0.814**	1.037
Predicted response to a 10 percentage point increase in percentage of nonwhite students in the school				
Regular teacher	1.023**	1.022**	1.060**	1.005
Regular teacher plus 2 qualifications	1.069**,++	1.067**,++	1.096**	1.067**,++
Predicted response to a 1 standard deviation increase in the percentage of free lunch students in the school				
Regular teacher	1.030**	1.023	0.994	1.064**
Regular teacher plus 2 qualifications	0.967,+	0.897**,++	0.957	1.088
Predicted response to a 10 percentage point increase in percentage of nonwhite students in the district				
Regular teacher	1.010	1.023**	1.005	0.983
Regular teacher plus 2 qualifications	0.960**,++	1.024	0.914**,++	0.880**,++
Panel B: Second or Later Spells				
Predicted response to a 10 percent increase in district salary (in average school)				
Regular teacher	1.016*	1.016	0.970	1.019
Regular teacher plus 2 qualifications	1.007	1.025	0.955	1.010
Predicted response to a 10 percentage point increase in percentage of nonwhite students in the school				
Regular teacher	1.022**	1.024**	1.042**	1.011
Regular teacher plus 2 qualifications	1.045**	1.015	1.065	1.081**,++
Predicted response to a 1 standard deviation increase in the percentage of free lunch students in the school				
Regular teacher	1.043**	1.002	1.099**	1.071**
Regular teacher plus 2 qualifications	1.026	0.983	1.022	1.091
Predicted response to a 10 percentage point increase in percentage of nonwhite students in the district				
Regular teacher	1.008	1.029**	1.018	0.968**
Regular teacher plus 2 qualifications	0.996	1.070**	1.037	0.869**,++

Notes: ++ and + denote whether the underlying hazard coefficient for a teacher with strong qualifications differs from the underlying hazard coefficient for a teacher with regular qualifications at the .05 level and .10 levels, respectively.
*statistically significant at the .10 level; **statistically significant at the .05 level.

increase in the school's free lunch percentage increases it by about 3 percent. Because the models separately control for student demographics at the district level, the simulated changes in school demographics should be interpreted as responses to changes in one school's characteristics relative to those of other schools. With the exception of a change in the school's free lunch percentage, which increases the probability that the teacher will switch to another school within the same district, the other demographic changes highlighted in the

Table 8. Salary Differentials (as a Percent of Salary) Required to Offset the Fraction Nonwhite at the School Level on the Overall Departure Hazard

	Difference in Nonwhite Share (Percentage Points)				
	10	20	30	40	50
Regular teacher	1.5	3.0	4.5	6.3	7.5
Strong teacher	10.2	23.1	34.7	46.3	58.3

table for a regular teacher all affect the odds that the teacher leaves the district or the profession, and not the odds of moving to another school within the district. For teachers with strong qualifications, the general patterns of hazard ratios are similar to those for regular teachers. Importantly, however, those with strong qualifications exhibit a much more muted response to salary differentials (0.944 hazard ratio vs. 0.861) and a more pronounced response to the nonwhite share of students (1.069 hazard ratio vs. 1.023).

These patterns indicate that salary differentials are a relatively powerful motivator for keeping regular teachers in their initial teaching spells in their original schools but a far less powerful motivator for teachers with strong qualifications. In particular, table 8 shows the simulated salary increases that would be required to counter the effects of differing percentages of nonwhite students in a particular school for the two types of teachers. For a regular teacher, the table indicates that a small salary increase of 3 percent would suffice to offset a 20 percentage point difference in the nonwhite share of students in the teacher's current school, and a 7.5 percent salary increase would offset a 50 percentage point difference. We note that these estimates, which under plausible assumptions once again are upper bounds, represent salary differentials that are within the range of observed salary differences in our data and are also within the realm of political feasibility.

To retain teachers with strong qualifications in schools with high nonwhite shares, in contrast, the required salary increases are far higher, ranging from over 10 percent to offset a small percentage point difference in the nonwhite share to 58.3 percent to offset a 50 percentage point difference. We note that these projected salary differentials are large relative to the observed variation in actual salaries in our data and hence represent out-of-sample predictions. While that means we cannot be very confident about the precise numbers, we can conclude that the salary differences required to retain teachers with strong qualifications are high and likely beyond the realm of political feasibility.[27]

27. This statement is true even with the additional qualification that the coefficients on the salary estimates may be biased downward, which would lead to an overstatement of the required salary differentials.

Consistent with this finding, salary also emerges as a relatively ineffective policy tool for changing the behavior of the more experienced teachers in later teaching spells. That conclusion emerges from panel B of table 7, which shows that salary differentials have little or no effect on the exit decisions of such teachers.[28] In particular, the entries in the top line indicate that a 10 percent increase in district salary could possibly even induce an increase in the hazard of exiting, although the coefficient is only marginally significant. Further, such a salary increase would have essentially no effect on the hazard ratio for teachers with strong qualifications.

At the same time, however, these experienced teachers respond just as strongly to the shares of nonwhite students or low-income students in their schools as do the teachers in initial spells, with teachers having strong qualifications being more responsive than those with regular qualifications. Because they tend to be established in a community, they are more likely than inexperienced teachers to respond to high percentages of nonwhite students in their current school by transferring to another school within the same district rather than moving to another district or dropping out of teaching. With respect to district-level differences in the share of nonwhite students in the district, both regular and strong teachers exhibit higher probabilities of leaving the profession. We have not replicated table 8 for teachers in these later teaching spells since the lack of responsiveness of such teachers to salary differentials rules out salary differentials as a tool for offsetting the demographic characteristics of the schools.

Responses to Other Labor Market Conditions, Including Local Bonus Programs

Tables 4 and 5 also provide results related to other labor market conditions. First, the coefficients on teacher salaries in surrounding districts indicate the expected finding that, controlling for the salary in her current district, a teacher is more likely to switch districts the higher the teacher salaries are elsewhere. Second, but somewhat harder to explain, is that a teacher is also more likely to change districts but not to leave the profession in response to higher nonteaching salaries in the local area. Given that we have also controlled for the local unemployment rate, however, those higher salaries in nonteaching jobs need not be associated with job openings. As expected, teachers respond to higher local unemployment rates by reducing the rate at which they leave the profession in the current year.

28. Based on a different model specification and with data from Texas, Hanushek, Kain, and Rivkin (2004) conclude that the power of salary differentials reaches a peak for teachers with 3–5 years of experience but falls off for more experienced teachers. Their findings seem roughly consistent with ours but are hard to compare, given that we focus on teaching spells, not years of experience.

Some positive, but at best limited, evidence emerges related to the Equity Plus programs in Charlotte-Mecklenburg and Winston-Salem. Recall that the relevant coefficients are those associated with designation as an Equity Plus program in the current year, controlling for whether a school ever met the criteria for the program. Consistent with the goals of these programs, three out of four of the relevant hazard ratios in the first column for teachers in either initial or subsequent spells are less than one. Although these coefficients suggest that the program was associated with a lower overall departure hazard, only one of them (for initial spells in Winston-Salem) is even marginally significant. The most significant of all the relevant coefficients related to the two programs is the 0.648 coefficient for the probability that a teacher in an initial teaching spell in Charlotte-Mecklenburg changes districts. It is a bit puzzling why the program in that city would reduce the odds that a teacher would leave the district but not the odds that she would leave the designated school in which she received the bonus.

The Statewide Bonus Program

Because of the complicated eligibility conditions surrounding the state's short-lived $1,800 bonus program, we augmented the basic models of the form shown in tables 4 and 5 with a set of six additional variables and limited the analysis to middle and high schools. Although the specifications are similar in spirit to those we present in Clotfelter et al. 2008, they differ in that these models are estimated separately for teachers in their initial or subsequent teaching spells, they differentiate exit routes, and they include only the teachers starting teaching spells during the relevant period. Of most interest are the coefficients of the variable indicating that a teacher was eligible to receive a $1,800 bonus.[29] The other coefficients refer to whether the teacher was eligible for the bonus (defined as a certified teacher of math, science, or special education) in an eligible school (defined as a high-poverty middle school or a low-performing high school), both directly and interacted with the years the program was in existence.

Table 9 reports results for all teachers in their initial spells (panel A) and for all teachers in subsequent spells (panel B). No distinction is made in this table between teachers with regular or strong qualifications.[30] The most compelling findings emerge in panel B. The relevant coefficients imply that, consistent

29. We used an indicator variable rather than adding the bonus amount to a teacher's salary because of the temporary nature of the bonus, which differentiates it from a permanent increase in salary (Clotfelter et al. 2008). The coefficient of the indicator represents a difference-in-difference estimate of the effect of receiving the bonus.
30. Models that interact all the bonus variables with a measure of strong preservice qualifications provide some hints that the effects may be more pronounced for regular than for strong teachers, but the differences are not statistically significant.

Table 9. Effects of the $1,800 Bonus Program

	All Exit Routes	Exit Route		
		Leave Teaching	Switch Districts	Change Schools
Panel A: Initial Teaching Spells				
Received $1,800 bonus	1.065	0.943	0.921	1.460**
Eligible teacher	0.969	0.979	1.007	0.890***
Eligible school	0.978	0.985	0.891*	1.013
Eligible teacher 2002–4	0.991	0.807***	1.102	1.328***
Eligible school 2002–4	1.018	1.063	0.937	1.002
Eligible teacher*Eligible school	0.992	0.981	1.135	0.962
Number of teacher-years	61,713	61,713	61,713	61,713
Panel B: Subsequent Teaching Spells				
Received $1,800 bonus	0.860*	0.719**	0.979	1.022
Eligible teacher	1.083***	1.210***	1.035	0.898**
Eligible school	0.970	1.013	0.880*	0.951
Eligible teacher 2002–4	0.996	0.941	1.141	1.052
Eligible school 2002–4	1.061	1.028	1.139	1.074
Eligible teacher*Eligible school	1.024	1.000	0.956	1.113
Number of teacher-years	50,904	50,904	50,904	50,904

*statistically significant at the .10 level; **statistically significant at the .05 level; ***statistically significant at the .01 level.

with the goals of the program, experienced teachers who received the bonus were 14 percent less likely to leave their school in the following year than were other teachers, all other factors held constant. In addition, they were 28 percent less likely to leave the profession. In contrast, the program did not have its intended effect on teachers in their first teaching spells and, in fact, appears to have increased the probability that they would move to another school within the district. These patterns are generally consistent with those from our earlier study, where we found that the statewide bonus program had a larger effect on experienced than on inexperienced teachers (Clotfelter, Ladd, and Vigdor 2008).

At the same time, the greater responsiveness to the bonus among the more experienced teachers may at first appear inconsistent with the results reported in table 8 showing larger responsiveness to salary differentials among teachers in their first spells. The two findings can be reconciled by the recognition that many teachers expected the bonus program to be short lived, which in fact it turned out to be. It is quite plausible that teachers in their first teaching spells would be far more responsive to permanent salary differentials than to short-term bonuses in making decisions about whether to remain in their current position. More experienced teachers, in contrast, may well perceive the bonus as a short-term incentive to remain in teaching or in their current school slightly longer than they otherwise would have.

6. CONCLUSION

Among the possible policies for ensuring equal access of racial and socioeconomic groups of students to quality educational resources at the school level, two are of particular interest. One is to distribute students of all groups evenly across schools, in which case the pattern by which resources (such as teachers with strong qualifications) are distributed across schools would have no adverse equity consequences. The racial desegregation that federal courts pushed in the 1960s and 1970s could be interpreted as a version of this first policy strategy. This approach has always been problematic, however, because existing patterns of residential segregation across states, counties, or other geographic regions make it difficult, if not impossible, to attain an even distribution of students across schools within districts, let alone metropolitan areas or states. Moreover, recent court decisions have all but precluded the possibility of using this strategy to promote educational equity within school districts.

A second method of promoting equity in the presence of school segregation is to use policy levers to equalize resources across schools. Research has consistently shown that the most significant educational resource—teacher quality—is distributed very unevenly among schools to the clear disadvantage of minority students and those from low-income families. The results of this study highlight the difficulties inherent in overcoming this historical pattern using the most obvious available financial policy lever—differential teacher salaries.

On the positive side, our analysis indicates that salary differentials do have some role to play in easing the challenge that hard-to-staff schools face in attracting teachers with strong qualifications. The more schools are segregated (particularly by race), the greater the required salary differentials needed to level the playing field. In addition, our results indicate that salary differentials of feasible magnitudes can counter the repelling effects of concentrations of disadvantaged students for at least one group of teachers—those with average qualifications who are in their first teaching spell.

On the negative side, salary differentials emerge as a far less effective tool for changing the school departure behavior of teachers with strong preservice qualifications or those who are no longer in their first teaching spells. This conclusion reflects our findings that such teachers are both more responsive to the racial and socioeconomic mix of a school's students and less responsive to salary than are their less well qualified counterparts when making decisions about remaining in their current school, moving to another school or district, or leaving the teaching profession. Thus, as we reported in table 8, for teachers with strong preservice qualifications in their initial teaching spells, the simulated salary differentials required to neutralize the effect of large concentrations of disadvantaged students are large and on the order of 40–50 percent of salary. In addition, taken literally, our estimates for teachers in subsequent spells imply that no salary differentials would be large enough to compensate them for being in schools with concentrations of disadvantaged students.

Given these findings, we are not optimistic about the power of salary differentials alone to promote educational equity in the context of schools that are highly segregated by educational disadvantage, and particularly by race. Although such differentials, whether in the form of permanent salary differences or short-run bonus programs, may reduce turnover in hard-to-staff schools, which in itself is a desirable outcome, and may keep some teachers from leaving the profession, they are far less effective in equalizing the quality of teachers across schools. Thus even with a judicious use of salary differentials specifically designed to promote a more equitable distribution of teachers across schools, the more segregated the schools are, the more unequal is likely to be the quality of teachers across schools.

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APPENDIX

DATA DEFINITIONS

Local Teacher Salary Supplements

Teacher salaries in North Carolina are the sum of (1) a mandated state portion taken from an annually revised schedule based on degree and years of experience and (2) an optional local supplement added by most school districts. Some districts offer a flat rate supplement for all teachers; others offer a uniform percentage increase in the state salary; and some make the supplement a function of such things as certification status, years of experience, or degree level. Since these formulas are not stored centrally, the information available to calculate them is generally not available for any but the most recent years covered by our data set. The only information on local supplements that is available over all years in our data set is the total amount of supplements paid by a district for a school year.

Since the form of the local supplement necessarily affects the salary schedule facing teachers in various districts, we sought to retain the differences in formulas. We therefore combined the aggregate amount paid in each district with information on the form of the supplement for the 2004–5 year, on the assumption that the form of the supplement did not change over time. Thus for districts whose local supplement was a flat amount in 2004–5, we assumed that their local supplements were flat amounts in other years. For these districts, therefore, we calculated each teacher's local supplement to be the average supplement paid to teachers in that district in the corresponding year. For districts whose supplements were simple percentages of the state-determined salary, we determined the rate as the ratio of the total local supplement for teachers to the total state salary bill for teachers in the district in that year.

For the districts that applied exact percentage rates to different classes of teachers, we computed the percentage rates that would yield a total district supplement equal to the reported total. For these districts, we first applied the 2004–5 rates by category (most of these districts differentiated by experience categories), calculated the implied total amount, noted the percentage error, then adjusted the rates for all categories proportionately so that the adjusted percentages yielded the correct district total. For a number of districts we were able to obtain the formulas used in 2001–2 and were able to compare the categories and percentage rates to those for 2004–5. If the earlier formulas differed, we used the 2001–2 formulas as the basis for the estimates for 2001–2 and earlier years, using the same approach described above.

For the remaining districts, whose local supplement was determined by more involved formulas, we compared the supplements given in tabular form to the pattern of salaries given in the state's salary tables to determine if the formula was closer to a flat amount or to a fixed proportion. Specifically, two parameters were calculated for the supplements given in tabular form: average experience progression (the average increase per year of experience calculated as an exponential growth rate) and the salary premium given to teachers with a master's degree as compared to those with a bachelor's. In the state's salary scale for 2004–5, average experience progression was 0.020, and the master's degree premium for teachers with ten years of experience was 10.0 percent. For districts that expressed their supplement in tabular format, the average experience progression was calculated by comparing supplements for bachelor's level teachers at three and twenty-nine years, and the master's degree premium, if any, was calculated at ten years of experience. A district was assumed to have a proportionate form for its supplement if either one of these rates exceeded the state rate or if both were more than half the state rate for that year. Otherwise, a district's supplement was assumed to be a flat amount for all teachers. Proportional formulas could be of four types: (1) a simple percentage of the state salary, (2) a percentage of the state salary based on the teacher's degree, (3) a percentage based on the teacher's experience (number of years teaching), and (4) a percentage that used both degree and experience. The breakdown of each type for the 117 districts in 2003–4 was (1) 73, (2) 2, (3) 8, and (4) 2; the remaining districts had either an additive supplement (22) or no supplement at all (10).

Arriving at a formula for each district that both retained the form that was used in 2004–5 and was consistent with the aggregate value of supplements paid in the district in a given year required a two-step estimation procedure. In the first step, the applicable formula for each district was used to calculate the supplement amount for each teacher in each district. In the second step, the formulas used in the first step were adjusted so that the total of all supplements calculated for each district would be equal to the total for the district given in the supplement data.

Alternative Teacher Salaries

To assess a teacher's earnings alternatives, we sought to calculate the average teacher salary available in nearby school districts. To keep to a reasonable level the amount of necessary calculations, we compared for one of six standard teacher profiles the salary available in a teacher's own district with the enrollment-weighted average salary available in districts within a thirty-mile radius (measured between centroids) of the teacher's own district. These six profiles combined two certificate types (bachelor's and master's) and three experience categories: 0–4 years of experience (median 2); 5–11 years (median 8), and 12 or more years (median assumed to be 18). The measure of relative teaching salaries is the logarithm of the ratio of the own-district teacher salary to the average regional teacher salary, both defined for the category into which each teacher falls.

To illustrate the importance of the functional form used in calculating local supplements, the salary ratio of Wake to neighboring Franklin County in 2003–4 ranged from 1.07 for inexperienced teachers with a bachelor's degree to 1.12 for teachers holding a master's having twelve or more years teaching experience.

Nonteaching Salaries

The measure of nonteaching salaries is the employment-weighted average of salaries in all counties within a thirty-mile radius of the (centroid of the) school district of the teacher in question. The definition of nonteaching earnings we use is private employment (equal to total employment minus farm employment and government employment), a definition that includes proprietors (from BEA Regional Economic Accounts Regional Economic Information System data 1995–2003; available www.bea.gov/regional/reis, Table CA-6, Compensation by Industry, and CA-25, Total Employment by Industry). An alternative definition, nonfarm wage and salary employment (nonfarm employment minus nonfarm proprietor employment), a definition that includes government, yielded similar results.

Classification of Schools by Level

In North Carolina, the most common grade ranges corresponding to each of the three school levels are elementary (K—5 or PK—5), middle school (6–8), and high school (9–12). In 1999–2000, over 70 percent of the state's public schools conformed to one of these grade ranges. To classify the remaining schools, each was assigned to the level in which most of its grades fell, or to the lower level in the case of equal numbers in two levels. Thus, for example, schools covering grades 3–5 are classified as elementary and those with 6–12 are classified as high schools.

College Selectivity

The categories were derived from information from *Barron's* College Admissions Selector for 1988, based on information for first-year students in each university in 1986–87. Our category "very competitive" includes universities rated as most competitive, highly competitive, or very competitive; "competitive" includes those rated as competitive; "less competitive" includes those rated as less competitive or noncompetitive; and "unranked" includes special programs such as art schools, international universities, or universities for which we were not able to find a rating. *Barron's* uses criteria such as the median entrance examination scores, percentages of students scoring five hundred and above and six hundred and above on both the math and verbal parts of the SAT or comparable scores for the ACT, the percentage of students who ranked in the upper fifth or two-fifths of their high school class, and the percentage of applicants who were accepted. If information for a university was missing for 1988, we substituted the ranking for the 1979 or 1999 selector, with the choice varying with the era in which the teacher attended college.

Teacher Test Scores

Teachers took a variety of standardized tests as part of the state's licensure requirements. We used results from nineteen of the most frequently taken tests. We formed a standardized licensure test score variable for each teacher by converting test scores from different test administrations in North Carolina to standardized scores using the means and standard deviations for tests taken in each year by all teachers in our data set. We normalized test scores on each of these tests separately for each year the test was administered based on means and standard deviations from test scores for all teachers in our data set and then assigned to each teacher the average standardized score on the tests taken by that teacher.

Classification of Districts

All districts in counties that were 45 percent or more urban in 1990 were classified as urban, as were all city districts in any county with enrollments of at least two thousand in 2001–2, not counting charter school enrollments. The boundaries between coastal, Piedmont, and mountain counties were taken from North Carolina Division of Travel and Tourism, *Yours to Discover: North Carolina State Parks and Recreation Areas* (1998). For the classification of specific districts, see Clotfelter, Ladd, and Vigdor (2003, Appendix A).

Table A.1. Descriptive Statistics for the Probit Sample

	Mean	SD	Min	Max
School Characteristics				
Middle	0.24	0.43	0	1
High school	0.28	0.45	0	1
Nonwhite, K–12 (%)	43.36	25.82	0	100.00
Building age	35.53	18.48	0	93.00
Free lunch, elementary (%)*	40.66	21.42	0	99.14
Free lunch, middle (%)*	33.22	18.47	0	94.87
Free lunch, high school (%)*	20.25	15.40	0	95.00
District Characteristics				
Free lunch (%)	30.56	11.81	0	75.87
Nonwhite (%)	40.81	18.57	0.82	97.42
Enrollment (ln)	10.00	1.08	6.50	11.66
Growth	0.02	0.01	−0.03	0.06
Rural	0.37	0.48	0	1
Coastal	0.16	0.36	0	1
Mountain	0.17	0.38	0	1
Beach	0.05	0.23	0	1
Salary (BA + 2) (ln)	10.16	0.08	9.97	10.31
Labor Market Characteristics				
Alt. salary (ln)	10.39	0.64	0	10.63
Unemployment rate	4.78	2.05	1.20	18.20
Years				
1997	0.12	0.33	0	1
1998	0.11	0.32	0	1
1999	0.12	0.33	0	1
2000	0.13	0.33	0	1
2001	0.12	0.33	0	1
2002	0.12	0.33	0	1
2003	0.12	0.32	0	1
2004	0.04	0.20	0	1
N = 129,388				

*Calculated separately by school level.