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ABSTRACT

We use value-added models to calculate measures of effectiveness for new elementary school teachers in Florida between 2001-02 and 2005-06, then compare the attrition and mobility patterns of more and less effective teachers overall and across various types of schools. While we do not find evidence that schools are disproportionately losing their most effective early career teachers, our data nonetheless suggest that there is considerable room for schools to raise student achievement and close achievement gaps through targeted policies aimed at retaining only their most effective performers. A clear majority of the state's most effective teachers do not remain in their initial schools only four years into their career, and these same teachers are no less likely to leave the profession altogether than are the least effective. Schools with high performing students do a far better job than most of retaining their most effective teachers and dismissing the least effective.

1. Introduction*

While the impact of per pupil spending, class size, and other school inputs on student achievement continue to be debated, there is a strong consensus that teacher quality is hugely important and varies widely, even within schools (see, e.g. Rockoff 2004, Nye et al. 2004, Hanushek et al. 2005, Rivkin et al. 2005).¹ Hiring and retaining more effective teachers thus has enormous potential for raising overall levels of student achievement and reducing gaps along lines of race and class. Indeed, it is no stretch to conclude, as Gordon et al. (2006) put it, that “Without the right people standing in front of the classroom, school reform is a futile exercise.” It is hardly surprising, then, that recent years have seen a surge in interest among researchers and policymakers in measures intended to improve the quality of the teaching workforce (Hess et al. 2004).

Among the most controversial strategies now under consideration is the introduction of performance pay plans that would tie teachers’ compensation directly to their students’ academic progress (Podgursky and Springer 2007). Arguments for performance pay in K-12 education typically emphasize the incentives they would create for current educators to make pedagogical or organizational changes to foster student learning. An equally important rationale for such policies, however, could be the recruitment and retention of teachers who are more effective in the classroom. Existing teacher compensation systems, which reward teachers based primarily on seniority and

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¹ Hanushek et al. (2005), for example, show that a student who has a teacher at the 85th percentile in terms of effectiveness can expect an annual achievement gain that is 0.22 standard deviations greater than a student who has the median teacher and that these benefits persist over time.

degree completion, offer no special inducement for more effective teachers to enter or remain in the profession. In fact, to the extent that the best teachers have superior earnings opportunities in other fields, they create a *disincentive* for them to continue teaching. As a result, there is widespread concern that the best teachers are leaving the schools where they are most needed for more affluent schools or more lucrative occupations.

There is a substantial literature on the correlates of teacher retention but far less research on the link between effectiveness and mobility. The research that does exist tends to measure the effectiveness of teachers who stay in the profession as compared to those who leave (e.g., Hanushek et al. 2005) or to compare the attrition rates of more effective teachers to those of less effective teachers (e.g., Krieg 2004, Goldhaber et al. 2007). Often a finding that leavers are no more effective than those who remain is interpreted as discrediting the concern that public schools are losing their best teachers to other professions or that schools serving disadvantaged students are losing their best teachers to more affluent schools. However, such an interpretation misses the point that the optimal pattern may be high attrition rates among the least effective teachers and low attrition rates among the most effective teachers.² While it is natural (and sensible) to measure overall differences in attrition and mobility rates by effectiveness, it is also important to examine the absolute attrition rates for different groups of teachers and whether they could (and should) be higher or lower.

² Our notion of optimality here is specific to education and the goal of raising student achievement. From the perspective of society, it may in fact be preferable for more effective teachers to enter other occupations where they will be more productive or to take administrative positions in the field of education. These considerations are beyond the scope of this analysis.

The present analysis addresses these issues through a descriptive analysis the early career paths of new elementary school teachers in the state of Florida between 2001-02 and 2005-06. We use value-added models to calculate measures of individual teacher effectiveness, then compare the attrition and mobility patterns of more and less effective teachers overall and across various types of schools. While we do not find evidence that schools are disproportionately losing their most effective early career teachers, our data nonetheless suggest that there is considerable room for schools to raise student achievement and close achievement gaps through targeted policies aimed at retaining only their most effective performers. A clear majority of the state's most effective teachers do not remain in their initial schools only four years into their career, and these same teachers are no are no less likely to leave the state's public schools system altogether than are the least effective. We also find that some Florida schools—namely those with the highest performing students—already do a far better job than most of retaining their most effective teachers and dismissing the least effective.

2. Previous Research

There is a large and growing body of evidence on the factors affecting teacher career decisions. It is well-documented, for example, that teachers prefer to work in schools with better working conditions and more advantaged student populations. Loeb et al. (2005) use teacher survey data to show that working conditions, including salaries, and student characteristics predict whether a teacher feels that turnover is a problem in his or her school. Lankford et al. (2002) find that teacher exit rates in New York state are far higher in urban schools serving disadvantaged students. And Hanushek et al. (2004),

using administrative data from Texas, find a strong relationship between student characteristics and teacher turnover as well as modest salary effects. For example, they find that schools with higher minority enrollment have markedly higher attrition rates among white teachers (although black and Hispanic teachers are less likely to leave).

In addition to these observational studies, there is also some quasi-experimental evidence that compensation and school characteristics affect teacher turnover. Clotfelter et al. (2006) analyze a program in North Carolina that awarded bonuses intended to retain math and science teachers in disadvantaged schools. Using panel data, they combine a difference-in-differences and regression discontinuity design and find that the bonuses decreased the mean turnover rate of the targeted teachers by about 12 percent.³ Jackson (2007) exploits a natural experiment created by the sudden end of a student busing program in Charlotte-Mecklenburg to show that increases in the share of low-income, minority students in a school led to declines in teacher quality as measured by experience, certification test scores, and estimated effectiveness. Interestingly, he finds no evidence that black and white teachers respond differently to student characteristics, suggesting that the correlation between teacher and student race reflects residential segregation rather than differing teacher preferences by race.

Research on the relationship between teacher effectiveness and rates of mobility and attrition is more limited. There is consistent evidence that teachers with better entering credentials, such as pre-collegiate test scores, are less likely to enter and remain in the teaching profession (e.g. Murnane et al. 1991, Podgursky et al. 2004). While this is interesting from a descriptive standpoint, more recent research calls into question the

³ The authors also argue, because survey data indicated that most teachers did not understand the program's mechanics, that their estimates likely understate what the effect of the program would have been had teachers been better informed.

value of teachers' observed characteristics as a proxy for teacher quality. In fact, Clotfelter et al. (2006) review numerous recent studies and conclude that they "find evidence of significant across-teacher variation in student test scores, but find little evidence that any observable teacher characteristic, save experience, explains any of this variation."

To our knowledge, only three studies have examined the relationship between mobility and attrition and teacher quality using direct measures of teachers' classroom effectiveness. Each of them finds that teacher effectiveness is in fact positively associated with retention in either specific schools or the profession. Using data from a single Texas districts, Hanushek et al. (2005) find that elementary and middle school teachers who remain in the same school are slightly more effective than those who switch schools or exit teaching and equally effective as those who switch districts. Nor do they find any evidence that the very best teachers within a school are most likely to leave. Krieg (2004) examines a single year of data on 4th grade students and their teachers in the state of Washington. He finds that more effective female teachers are less likely to leave the profession but that there is no clear relationship between attrition and effectiveness for male teachers. Finally, Goldhaber et al. (2007) use statewide data on newly hired North Carolina teachers between 1996 and 2002 to show that more effective teachers are less likely to leave their initial schools or the profession.

Our analysis extends this emerging line of research in several ways. First, like Goldhaber et al. (2007), we use a panel dataset that allow us to track mobility and attrition among new teachers in an entire state over an extended period of time. Second, we compare the relative attrition of more and less effective teachers across several types

of schools, including schools classified according to their students' achievement, enabling us to see whether high-performing schools do a better job of retaining effective teachers while weeding our weaker ones. Finally, rather than presenting evidence only on the differences in effectiveness between teachers who remain in their initial schools and those who move (or leave the profession), we also provide information on the absolute mobility and attrition rates of teachers grouped according to their effectiveness—information which we believe holds great relevance for the design of teacher labor-market policies.

3. Teacher Policy and Teacher Mobility in Florida

In recent years, the combination of population growth and class-size reduction policies has dramatically increased the demand for teachers in Florida. The school-age population in the state increased by 6 percent (from 2,708,000 to 2,869,000) between 2000 and 2005, a period in which the national school-age population grew by only 0.02 percent (U.S. Department of Education 2007). Perhaps more importantly, in November 2002 voters approved an amendment to the Florida Constitution establishing maximum class-sizes of 18 students in grades K-3, 22 students in grade 4-8, and 25 students in high school to be attained by the 2010-11 school year. Implementing legislation passed in 2003 mandated a 2 student per year reduction in district average class sizes from 2003-04 until 2005-06; a two student reduction in school averages during the 2006-2007 and 2007-08 school years; and a two student reduction in individual classroom averages in 2008-09 until goals are reached prior to or during the 2010-11 school year. As a

consequence, average class sizes statewide decreased by 6.12 students in grades K-3 and 4.75 students in grades 4-8 between the 2003-04 and 2006-07 school years.

In response to the hiring pressures stemming from these developments, the legislature has established two innovative programs that provide alternative routes into teaching: Educator Preparation Institutes at community colleges and district-based alternative certification programs. The state's Department of Education has also invested considerable resources in recruiting out-of-state teachers and proposed legislation that would encourage former military personnel and military spouses to enter the classroom. However, there remains an urgent need to increase the supply of teachers entering Florida's classrooms that presumably also provides strong incentives for schools and districts to retain their current teachers.

While the Florida legislature has, since 2006, passed two landmark laws mandating that each of its 67 school districts adopt plans that would make teachers eligible for bonuses based on their students' academic progress (Hanushek 2006, Buddin et al. 2007), the use of performance pay in Florida during the time period we examine was fairly limited, especially for elementary school teachers. The most important exception is the School Recognition Program, which since 2002 has offered awards of \$100 per full-time equivalent student to each school which improves its grade on the state's accountability system or maintains its ranking in the highest category. Although most recognized schools distribute the bulk of these funds directly to faculty, they typically do so relatively evenly among teachers and staff. As a result, the bonuses for classroom teachers typically amount to less than \$1,000 per teacher.⁴ The state also offers

⁴ The median award for all Florida teachers receiving bonuses through the School Recognition Program is \$920.

bonuses to teachers who have attained National Board certification and for teachers whose students pass AP exams, but these programs are generally not relevant for early career teachers in the elementary grades. Finally, the use of bonuses to recruit and retain teachers in hard-to-staff schools and subjects is not widespread in the state. There is little reason, then, to think that Florida's tentative early steps toward differentiated compensation for teachers had a measurable impact on the attrition and mobility patterns we document below.

Figures 2 through 4 provide an overview of mobility and attrition among 4th- and 5th-grade regular classroom teachers in Florida during this period. Figure 2a tracks all 11,076 4th- and 5th-grade regular classroom teachers in 2001-2002 through the 2005-06 academic year, the most recent for which data are available. The percentage remaining in the same school after one year is about 82 percent, but drops to around 50 percent by the fourth year. The one-year mobility and attrition rates is remarkably close to the national average for elementary school teachers in 2003-04, which show that 83 percent of all teachers remained in the same school, 9 percent moved to a different school, and 8 percent left the profession by 2004-05 (U.S. Department of Education 2007). Most movement across schools in Florida is within districts rather than between districts, but teachers who leave the Florida public schools altogether outnumber the combined share of teachers who switch schools either within or between districts in each year.

Figure 2b shows the same statistics for the 2,313 4th- and 5th-grade teachers who entered the profession between 2001-02 and 2004-05, the group that is the focus of our analysis. Rather than organize the data for these teachers by chronological year, we instead track each teacher's movements relative to his or her first year of teaching.

Because we can follow teachers only through 2005-06, we observe the cohorts of teachers entering after 2001-02 for fewer than five years. The size of the samples on which each data point is based therefore grows smaller with each successive year. The figure confirms that this group of new teachers is much more mobile than the full sample of teachers in the same grades, much as one might expect of any worker early in his or her career. Only 65 percent of teachers remain in the same school for a second year, and by the fifth year more teachers have left the profession than remain at the same school. As with the full group of teachers, most of the movement of teachers among schools occurs within districts rather than between districts.

Of course, when a new teacher switches schools but does not exit the profession, one school's loss is another school's gain.⁵ From a system-wide standpoint, movement of teachers across schools could have a negligible impact on student achievement if transaction (moving) costs are low and a year of experience in a school will prepare the teacher for a different school just as well as a year of experience in the new school would have. Teacher mobility could even be beneficial to student achievement if teachers sort themselves into the schools in which they are most effective. Of course, another plausible equilibrium is one in which the best teachers end up at the schools with the most favorable working conditions (e.g., high salaries, good neighborhood, students from affluent families, etc.) where they instruct the students who arguably need them the least. One might expect this to occur if salary differences are small across schools (so only compensating differentials affect job choice) or if schools with wealthier families are able to offer higher salaries to attract high-quality teachers. In Florida, school districts (which

⁵ The gain/loss here is the teacher; if one thinks of this in terms of teacher effectiveness, one school's gain (through the departure of a low-quality teacher) could be another school's loss.

are coterminous with counties) are generally very large, so the former hypothesis is likely more relevant than the latter.

Figures 3 and 4 offer some basic evidence as to how the mobility of new 4th- and 5th-grade teachers varies according to the characteristics of their school's student body. There are substantial differences in the rate with which new teachers remain in their initial school, with teachers more likely to stay in low-minority and low-poverty schools than in high-minority and high-poverty schools. This constitutes suggestive evidence, based on the link between teacher experience and effectiveness, that teacher attrition may have a larger negative impact at schools that serve primarily disadvantaged students. It could, however, be that the difficult working conditions of urban schools more efficiently weed out less effective teachers and thus that higher teacher attrition at these schools is actually beneficial for student achievement. Our analysis below sheds light on these issues.

4. Measuring Teacher Effectiveness and the Florida Database

Research on teacher quality has traditionally used observed teacher characteristics (e.g. experience, graduate degrees, college selectivity, or certification test scores), as proxies for unobserved ability. As discussed above, however, recent findings have cast considerable doubt on the relationship between these indicators and classroom effectiveness. In this paper we use the term “effectiveness” and “quality” interchangeably to refer only to the effect that a teacher has on his or her students' test scores. Of course teacher quality has other dimensions, most of which are difficult to measure and all of which are outside the scope of this paper. The value of the present analysis and findings

hinges on the assumption that the test instruments used are, on average, a reasonable measure of students' overall academic development. The following sections explain our approach to measuring teacher effectiveness and the database with which we implement it.

4a. Empirical Strategy

We examine the relationship between teacher effectiveness and mobility by computing a value-added measure for each teacher, grouping teachers based on their tercile in the distribution of this effectiveness measure, and then describing by tercile the career paths of four new cohorts of teachers over up to five years. While the description of career paths by effectiveness tercile is straightforward, the estimation of a credible value-added measure is more challenging.

There is little consensus among researchers who study teacher quality as to the preferred empirical specification of the relationship between test scores and student, teacher, and school characteristics. Harris and Sass (2006) review the methods used in recent studies of teacher quality and, using the same database as this paper, analyze the effectiveness of mathematics teachers in 100 Florida middle schools. They find that the "restricted value-added" model, in which a student gain score is the dependent variable, is a reasonable approximation of the cumulative achievement model, which involves controlling for multiple previous years of educational inputs and is more cumbersome (or impossible, given data limitations) to estimate. We describe our particular specification of this model below, but first discuss the construction of the dependent variable.

Hanushek et al. (2005) find that average student learning gains on the Texas Assessment of Academic Skills vary widely by the student's place in the initial test score

distribution. Specifically, they find that students who start out with a lower score are likely to make much larger gains than students who start out with a higher score. Figure 1 shows that the same pattern is evident on the Florida Comprehensive Assessment Test (FCAT), which we rely on as our primary measure of student achievement when estimating teacher effectiveness. Although this figure is based only on the math FCAT, we find a similar relationship on the reading FCAT and even stronger ones on both the math and reading components of the Stanford Achievement Test (SAT), which we use as an alternate measure of student achievement. While part of this pattern could be attributable to mean reversion induced by measurement error, the consistency of the relationship through the middle of the distribution suggests that this is not the entire story. Rather, it seems that the tests are constructed such that students who begin at a lower level are more likely to make improvements that are reflected in the items included.

As Hanushek et al. (2005) note, converting the scores to a percentile ranking would attenuate the correlation between initial score and expected gain, but would not deal with the possibility that identical differences in teacher quality could lead to different test score gains for students at different places in the initial test score distribution. Their preferred correction is to standardize test score gains by grade and year within each of ten equally spaced test score intervals. We take a similar approach, but instead standardize test score gains by grade, year, and decile of the initial distribution of student test scores. These decile-standardized gains serve as the dependent variable throughout our analysis of teacher effectiveness.

All of the models we use to estimate teacher effectiveness regress decile-standardized test-score gains on vectors of student, classroom, and school characteristics and dummy variables for teacher experience,⁶ and grade-by-year fixed effects. Student-level controls include number of days absent the previous year as well as dummy variables for race, gender, limited English proficiency status, special education status, migrant status, whether the student was in a different school the previous year, and free or reduced-price lunch eligibility. Classroom- and school-level characteristics include all of the student-level characteristics aggregated to the appropriate level. We also control for class size and the percent of students in the classroom and school who were repeating a grade. The teacher value-added measure for each test is calculated as the average of the student-level residuals for a teacher's class in a given year. The model, which is similar to that employed by Kane et al. (2006) in their study of New York City teachers, is:

$$\Delta A_{it} = \beta X_{it} + \gamma C_{it} + \phi S_{it} + \delta W_{it} + \pi_{it} + \varepsilon_{it}, \quad (1)$$

where ΔA_{it} is the decile-standardized test-score gain of student i in year t ; X , C , and S include student-, classroom-, and school-level characteristics; W is a vector of teacher experience dummy variables; π is a vector of grade-by-year fixed effects, and ε is a standard zero-mean error term. We estimate equation (1) separately by subject (reading and math) and test (FCAT and SAT) and average the residuals by teacher and year to construct four value-added measures of teacher effectiveness.

The key confounding factor in the estimation of the impact of teachers on student achievement is the non-random matching of students and teachers that occurs both across and within schools. For example, families chose where to live based in part on the quality

⁶ We include a dummy variable for each of the first 20 years of experience, so the omitted category includes all teachers with more than 20 years of experience.

of local schools, and pay a premium for better schools through higher house prices and property taxes. This non-random sorting of families across schools will bias our estimates of teacher quality if there are unobserved differences across students that cannot be controlled for using the variables described above. One way to confront this issue is to focus on differences in teacher-quality within schools through the inclusion of school fixed effects, which eliminates any bias resulting from non-random sorting of families across schools but does so at the cost of ignoring any differences in teacher quality across schools. We do not include school fixed effects in our preferred specification in order to allow for comparisons of teachers across schools.⁷ However, all of the results we present below are qualitatively similar to those found when we estimate teacher effectiveness conditional on school fixed effects.

The second source of bias, non-random matching of students and teachers within schools, occurs if students are assigned to teachers based on the characteristics of either. This could occur through more motivated parents pressuring the school to assign their children to teachers they perceive as better, more senior teachers being rewarded with classes that have fewer behavior problems, or administrators trying to match students with the most appropriate teacher. If it occurs based on unobserved characteristics, such within-school matching will also bias our estimates of teacher quality, though the direction of this bias is unclear. One way to deal with the non-random matching of teachers and students within schools is to include student fixed effects. However, this strategy only allows one to compare teachers who teach similar students, so comparisons

⁷ As Jackson (2007) explains, “Specifications that include student or school fixed-effects identify teacher value-added based on within-school or within-student variation. If teachers are very different across schools, then much of the variation in teacher quality (i.e. the cross-school variation) will be absorbed by the school fixed-effect, making estimated effects across schools impossible to compare.”

of teachers who teach different students (even within the same school) may be misguided (Jackson 2007). Given that one of our objectives in this paper is to assess how teacher effectiveness is related to attrition and mobility in the state as a whole, we do not estimate models that include student fixed effects.

In a recent working paper, Rothstein (2007) finds evidence that the non-random matching of teachers and students on unobserved characteristics undermines the identification of credible teacher value-added measures, even in specifications using school or student fixed effects. However, it is unclear whether and in what direction such non-random matching would bias the results presented in this paper. The non-random matching of students and teachers based on unobserved characteristics will increase measurement error in our teacher effectiveness ratings, thereby attenuating estimated differences in mobility patterns between teachers in different terciles of the effectiveness distribution. However, it is unclear a priori whether the additional error will be systematically related to teacher mobility.

Different types of teacher-student matching would produce different biases. For example, if better teachers are systematically assigned to better students (i.e., those with larger expected future test-score gains conditional on their observed characteristics) then the standard deviation of the teacher effectiveness measure will be overstated but the ranking of teachers (and thus their assignment to terciles) would stay the same. Alternatively, principals could assign better students to effective teachers who are threatening to leave in an attempt to convince them to stay, in which case it would appear that more effective teachers are more prone to stay (assuming the assignment of better students achieves its goal).

4b. Data

The information with which we implement this approach comes from the K-12 Education Data Warehouse assembled by the Florida Department of Education. Our data extract contains observations on every student in Florida who took the state assessment tests between 1998-1999 and 2005-2006, and each student in the database is linked to his or her teacher(s) for 2001-2002 through 2005-2006. The data include test score results from the Florida Comprehensive Assessment Test (FCAT), the state accountability system's "high stakes" test, as well as the Stanford Achievement Test (SAT), a nationally norm-referenced test that is administered to students at the same time as the FCAT but is not used for accountability purposes. Beginning in 2000-2001, students in grades three through ten were tested every year in math and reading. Thus annual gain scores can be calculated for virtually all students in grades four through ten beginning in 2001-2002. The data also contain information on the demographic and educational characteristics of the students, including gender, race, free or reduced-price lunch eligibility, limited English proficiency status, special education status, days in attendance, and age.

Our teacher data files contain detailed information on individual teachers, including demographic information, experience, employment, compensation, results from the certification exam, and postsecondary institution and major. The present analysis only employs information from the employment and experience files. We use the employment data (the course enrollment file which matches students and teachers) to track where teachers are employed each year and to link them to their students. We use the experience data to identify the cohort of 4th- and 5th-grade teachers that entered the teaching

profession between 2001-2002 and 2004-05.⁸ The teacher experience variable we construct includes all years the teacher has spent in the profession, including both public and non-public schools in both Florida and other states.

The results presented below use measures of teacher effectiveness based on FCAT math and reading test scores only. Because the FCAT is the test for which schools are held accountable, schools should have a particularly strong incentive to retain those teachers who are effective in raising student achievement on that test. The choice of which test to use, however, makes little difference to our results. The effectiveness of teachers as measured by their students' FCAT performance is highly correlated with their effectiveness as measured by the SAT, and the attrition and mobility patterns documented below are similar regardless of which test we use to gauge effectiveness.

We calculate gain scores as the difference in student i 's score in year t and grade g and the same student's score in year $t-1$ and grade $g-1$. As previously discussed, we standardize these gain scores to have a mean of zero and a standard deviation of one within each grade, year, and decile of the initial test score distribution (i.e., the distribution of test scores of students in year $t-1$ and grade $g-1$). We only calculate gain scores (and thus only include in the analyses of teacher effectiveness) students who did not repeat or skip a grade.⁹

We limit our analysis to 4th- and 5th-grade students and their teachers, as these students typically only have one primary math and reading teacher (their regular

⁸ Because the experience database does not reliably distinguish teachers with zero experience and those with missing experience data, we define the cohort of new teachers in a given year as those who have missing or zero experience that year and were not employed by a Florida public school in the previous year.

⁹ The number of students who skipped a grade is trivial, while the number who repeated a grade is substantial. The repeaters are included in the calculation of classroom- and school-level peer variables. We also calculate, and include in all regressions, variables indicating the percent of students in each classroom and school who were repeating a grade.

classroom teacher). Students who had more than one classroom teacher or are in a classroom of fewer than 10 or more than 50 students are dropped from this analysis.¹⁰ The data on which this analysis is based span from 2001-2002, the first year for which we can calculate gain scores for 4th - and 5th-graders in both reading and math, to 2005-2006, the most recent year for which data are currently available.

5. Results

Our estimates based on equation (1) are consistent with previous findings on both returns to experience and variation in teacher effectiveness. In math, the students of first- and second-year teachers have gain scores about 5 percent and 2 percent of a standard deviation lower, respectively, than very experienced teachers (those with more than 20 years of experience). Teachers between the 3rd and 20th year of experience are all about as effective as teachers with more than 20 years of experience. In reading, the gain scores of students of first- and second-year teachers are about 9 percent and 6 percent of a standard deviation lower, respectively, than very experienced teachers. Students of teachers in their 3rd through 7th years also score about four percent of a standard deviation lower in reading than do those of the most experienced teachers.

The standard deviation of our teacher effectiveness measures, once adjusted for sampling error, is also similar to that found in previous work. Using the method described by Kane et al. (2006) to separate the persistent and non-persistent components of the teacher effectiveness measure, we estimate a standard deviation of the persistent component of 0.18 in math and 0.09 in reading. Kane et al. find comparable figures of

¹⁰ A large and increasing number of elementary grade students in Florida appear to have more than one regular classroom teacher, perhaps due to an increase in “team teaching.” In future work we hope to develop effectiveness measures for this group.

0.13 in math and 0.10 in reading using data from elementary schools in New York City.¹¹ In other words, the effectiveness of 4th- and 5th-grade teachers in the state of Florida as measured by their students' academic progress varies enormously, as has been the case in every context in which this question has been examined.

5a. Mobility and attrition by effectiveness tercile

We use the results of equation (1) to divide all teachers in Florida who were in charge of a 4th- or 5th-grade classroom between 2001-02 and 2005-06 into thirds based on their average effectiveness score in both math and reading during the time that they were employed at the school where they taught in their first year.¹² The differences in the average effectiveness of teachers in each of these terciles are substantial. Students assigned to a bottom-third teacher could expect to make gains on the math FCAT 0.15 standard deviations smaller than had they been assigned to a teacher in the middle third, while students assigned to a top-third teacher could expect to make gains that were 0.15 standard deviations larger. On the reading FCAT, the expected gains for students of bottom-third and top-third teachers would be -0.08 and 0.08 standard deviations, respectively.

We then focus on the 2,313 of these teachers who entered the profession from 2001-02 and 2004-05. These teachers are somewhat clustered in the bottom of the effectiveness distribution, with just over 40 percent falling in the bottom third and the remaining 60 percent evenly divided among the middle and top thirds. The concentration

¹¹ The standard deviation of our raw teacher effectiveness measure (including both the persistent and non-persistent components) is substantially larger than that calculated by Kane et al. (2006), which is attributable to our use of a gain score as the dependent variable. Kane et al. (2006) instead estimate a model in which test-score levels are regressed on a polynomial in prior test scores.

¹² In other words, any time a teacher spent at a school other than the one where they worked in their first year of teaching does not contribute to their effectiveness measure. We take this approach because of our interest in whether schools are retaining teachers based on their observed performance in their initial school.

of new teachers among the least effective could reflect either a cohort effect (with teachers entering Florida being less effective than previous entrants) or imperfections in our adjustment for the effects of experience.¹³ Fortunately, neither possibility is a problem for our analysis of early career mobility and attrition across the three groups.

Figures 5 and 6 track the mobility of new teachers separately within each of these terciles. Mobility behavior is described by two binary variables: whether the teacher was still in the same school (Figure 5) and whether the teacher was still in the profession (Figure 6). It is important to keep in mind that our data do not allow us to distinguish between voluntary and involuntary movement among teachers—that is, between involuntary transfers and dismissals and voluntary decisions to seek out a new school or leave the teaching profession. Conventional wisdom, however, would suggest that most mobility and attrition is voluntary, even among new teachers, and the patterns we observe generally provide no strong reason to think otherwise.

Contrary to common preconceptions (but consistent with previous research), we find that the most effective teachers are actually more likely to remain in their original schools than are teachers in the bottom third of the effectiveness distribution. The differences are especially pronounced in the first three years. By the second year of teaching, only 59 percent of bottom-third teachers remain in their original schools, as compared with roughly 70 percent of both middle- and top-third teachers. These differences in retention rates narrow somewhat over time but remain evident (and statistically significant at the 85 percent level) by year five.

¹³ We find some suggestive evidence in support of the former possibility, as the effectiveness ratings of teachers who entered in 2003-04 and 2004-05 when the state's class-size reduction mandate increased the number of new teachers hired in these grades are especially low.

At the same time, Figure 5 also suggests that schools would be well-served by doing more to retain their most effective teachers—as fewer than 30 percent remain in their original school by year five—as well as by dismissing more of the worst teachers before they are granted tenure, which in Florida generally occurs between the third and fourth years of teaching. The fact that there is no sharp drop in retention rates at this point, either overall or for the least effective teachers, suggests that schools are not using the tenure decision process to weed out probationary teachers who have been ineffective in the classroom. The markedly higher mobility rates of bottom-third teachers in the first three years, however, could indicate that schools are counseling out their worst performers.

Figure 6, which examines the rate at which teachers remain in any public school in Florida, paints a somewhat different picture. While bottom-third teachers are still less likely to remain in the profession through the third year of teaching, the differences across terciles are small and disappear altogether by year five. At this point, only about 60 percent of the top-third teachers remain in Florida schools, and again suggesting the potential value of targeted policies to increase retention for this group. Importantly, the difference between school-level and statewide retention patterns suggests that the least effective teachers, though they are more likely to leave their initial schools, are often successful in gaining employment elsewhere in the Florida public school system.

5b. School characteristics and mobility by effectiveness tercile

Of course, it is possible that the relationship between teacher mobility and teacher effectiveness varies according to the characteristics of the school. For example, it may be the case that schools serving disadvantaged students lose their most effective teachers to

schools with more desirable teaching environments and are left with only their worst performers. Figures 7a and 7b track the mobility of new teachers out of schools with large (more than two-thirds) shares of minority and poor students, respectively. As above, we find that overall levels of attrition are substantially higher in high-minority and high-poverty schools than is the case in schools statewide. The *relative* attrition rates of the most and least effective teachers, however, are quite similar to the patterns elsewhere. Specifically, bottom-third teachers are roughly 10 percentage points more likely to leave their original schools in the first two years of teaching than are middle- or top-third teachers. These schools do appear to suffer from a dropoff in retention rates among the most effective teachers in year five, but this result should be interpreted cautiously because it is based on data from only a single cohort of new teachers.

Figure 7c looks separately at teacher mobility in the 273 elementary schools with at least one teacher in our sample in which more than two-thirds of students score at proficient levels in both math and reading on the FCAT. Interestingly, at these relatively high-performing schools, the retention rates of the most and least effective teachers appear to diverge sharply by years four and five. By year four, only 20 percent of the least effective teachers remain in their initial school, as compared with more than 40 percent of the most effective teachers. By year five, fewer than 10 percent of the bottom-third teachers remain in their school. This pattern, which contrasts sharply from what is observed for the state's schools as a whole, suggests that the most successful schools in the state do a better job of selectively retaining their strongest teachers. And although we still cannot distinguish between teacher dismissals and voluntary departures, the extremely small shares of ineffective teachers remaining in schools that we would expect

to have more desirable teaching environments suggests that they are also more aggressive in weeding out poorly performing teachers early in their careers. Both of these factors may play a role in the schools' overall success.

5c. Characteristics of new and old schools for switchers

The results presented thus far confirm that 4th- and 5th-grade teachers in Florida are highly mobile in the early years of their careers, and that much of their mobility appears to be voluntary. We can gain some insight into the factors influencing the movement of teachers among schools and districts and its consequences for students by comparing the characteristics of teachers' original schools before and after each move. It is important to keep in mind that this analysis is purely descriptive. We have no basis for drawing strong causal inferences about the effects of particular school characteristics on teacher mobility. Nonetheless, the patterns we observe are consistent with the notion that school working conditions, as reflected in the demographic and educational characteristics of their student bodies, play a major role in decisions about where to teach.

Table 1 compares the characteristics of the old and new schools of teachers who left their initial school but continued to teach in the state of Florida. It provides clear evidence that teachers who switch schools tend to move into higher-performing schools with more advantaged student bodies. Among those who remained in the same district, movers on average experienced a 22 percent decline in the share of students who were black and a 13 percent decline in the share eligible for the free or reduced-price lunch program. The new schools teachers entered also had larger shares of students who were proficient on the FCAT in math and reading and received better overall scores on the

state's highly visible school grading system, half of which is based on students' annual gains in achievement.

These changes in school characteristics were even more pronounced for teachers moving between districts. These teachers experienced a 31 percent decline in the share of black students, a 21 percent decline in the share of students eligible for a free lunch, and increases of 22 percent and 16 percent, respectively, in the percentage of students who were proficient in math and reading. District switchers also saw a jump in their annual base salaries of 24 percent, or more than \$6,400. The average salary increase of \$4,000 salary experienced by within-district movers, who typically remained on the same salary schedule, provide a rough benchmark for evaluating this jump and suggest that district switchers do tend to choose systems with higher overall salary levels.

Table 2 looks separately at the changes experienced by switchers within each of the three effectiveness terciles, combining the data from both within- and between-district switchers for all characteristics except base salary because of the relatively small number of between-district moves in each group. These data confirm that the tendency of teachers to move to schools with less disadvantaged student bodies is not unique to teachers in the top or middle thirds of the effectiveness distribution. If anything, bottom-third teachers experience larger declines in the share of students who are black and larger increases in student academic performance as they move between schools. This may reflect the fact that these teachers tend to start out in schools that have somewhat more disadvantaged and lower-performing student bodies, a reminder that it is important to pay attention to the initial distribution of teachers as well as to their mobility.

In sum, it is clear that effective and ineffective teachers alike tend to migrate in the early years of their career toward higher-performing schools with more advantaged student bodies. This pattern suggests that schools that attract experienced applicants may not do a very good job of selecting only those teachers with a successful track record in the classroom, at least as measured by the academic progress of the students under their care.

6. Conclusion

The United States currently faces the daunting challenge of hiring large numbers of new teachers while simultaneously improving the quality of its teaching workforce. In Florida, these pressures are particularly acute because of the state's commitment to dramatic reductions in class size by the end of this decade. The difficulty of predicting the effectiveness of teachers based on what is known about them before they enter the profession—the kind of information included on their resume—means that retaining those teachers who have demonstrated their effectiveness in the classroom is essential to accomplishing the task.

How are our schools fairing in this regard? Is the glass of the teacher labor market half-empty or half-full? How one answers these questions will depend in part on one's prior expectations. If we suspect that the nation's most effective teachers are fleeing the classroom in droves, then even a finding that leavers are little different than those who stay may be seen as reassuring, however odd such a pattern would appear in other sectors of the economy.

At least in Florida, our results also suggest that the answer will depend on the level at which one conducts the analysis. When we compare the mobility rates of the most and least effective teachers at specific schools, we find that the least effective are actually somewhat more likely to leave in the first years of their careers. And schools with high-performing students are able to retain a bare majority of their most effective teachers while dismissing all but a handful of their worst performers. Figure 8a, which shows the overall distribution of effectiveness of those who have stayed in their school and those who have moved on by year four, confirms that the “stayers” do tend to be modestly more effective. Looking at the state public school system as whole, however, the pattern is less encouraging. Figure 8b confirms that there is little difference in the effectiveness of those who remain in the profession and those who leave. The disparity between mobility and attrition patterns in the state is consistent with the notion that public schools often engage in a “dance of the lemons” (Schweitzer 1999), in which poorly performing teachers are passed from one school to another rather than being dismissed.

Perhaps surprisingly, we find little evidence that schools serving disadvantaged students are especially likely to lose their best teachers. Rather, the tendency of teachers to drift schools with more favorable student characteristics is evident among both low and high performers. It is important to emphasize that this does not imply that schools serving more disadvantaged students are not adversely affected by current mobility patterns among new teachers. Indeed, given the value of classroom experience, the higher overall attrition rates at these schools should be a matter of considerable concern. But policies aimed at increasing retention in schools serving disadvantaged students will be

far more beneficial for students if they aim at retaining their most effective teachers, not just at lower turnover rates alone.

Discussions of differentiated compensation in education often treat financial incentives for performance and retention as separate issues. Proposed performance pay schemes, including those recently enacted in Florida, would make all teachers eligible for bonuses based on their students' academic progress. Retention bonuses in turn would be available for all qualified teachers accepting assignments in hard-to-staff schools or subject areas. While much more research is needed on the extent to which teachers are responsive to the incentives created by such policies, combining the two approaches—for example by offering larger performance incentives in hard-to-staff schools—may represent a promising approach to improving both overall teacher quality and the allocation of teachers across schools.

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Figure 1. Standardization of FCAT Math Test-Score Gains

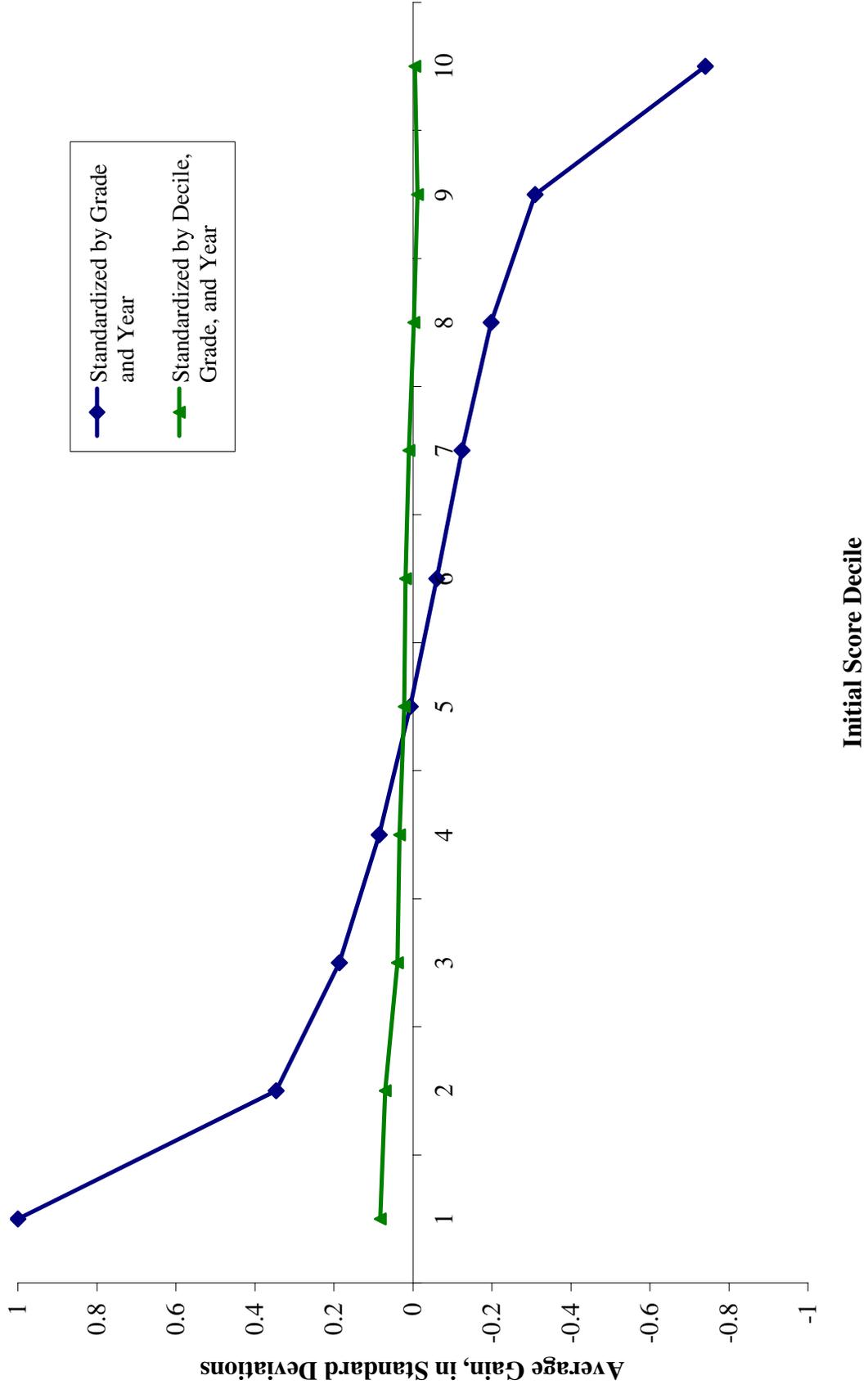


Figure 2a. Status of All 2001-2002 4th- and 5th-Grade Classroom Teachers (N=11,076)

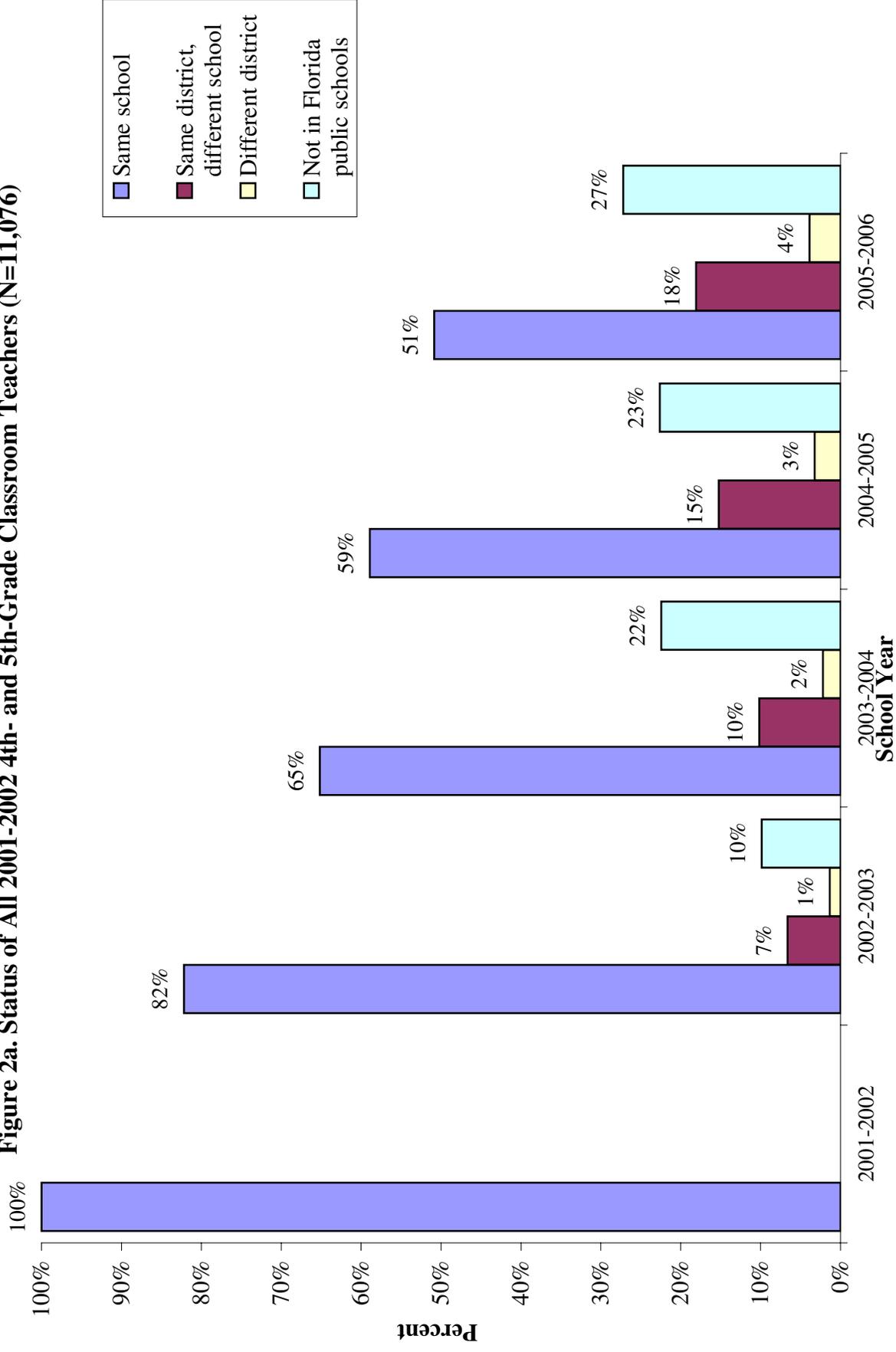


Figure 2b. Status of New Teachers Over Time

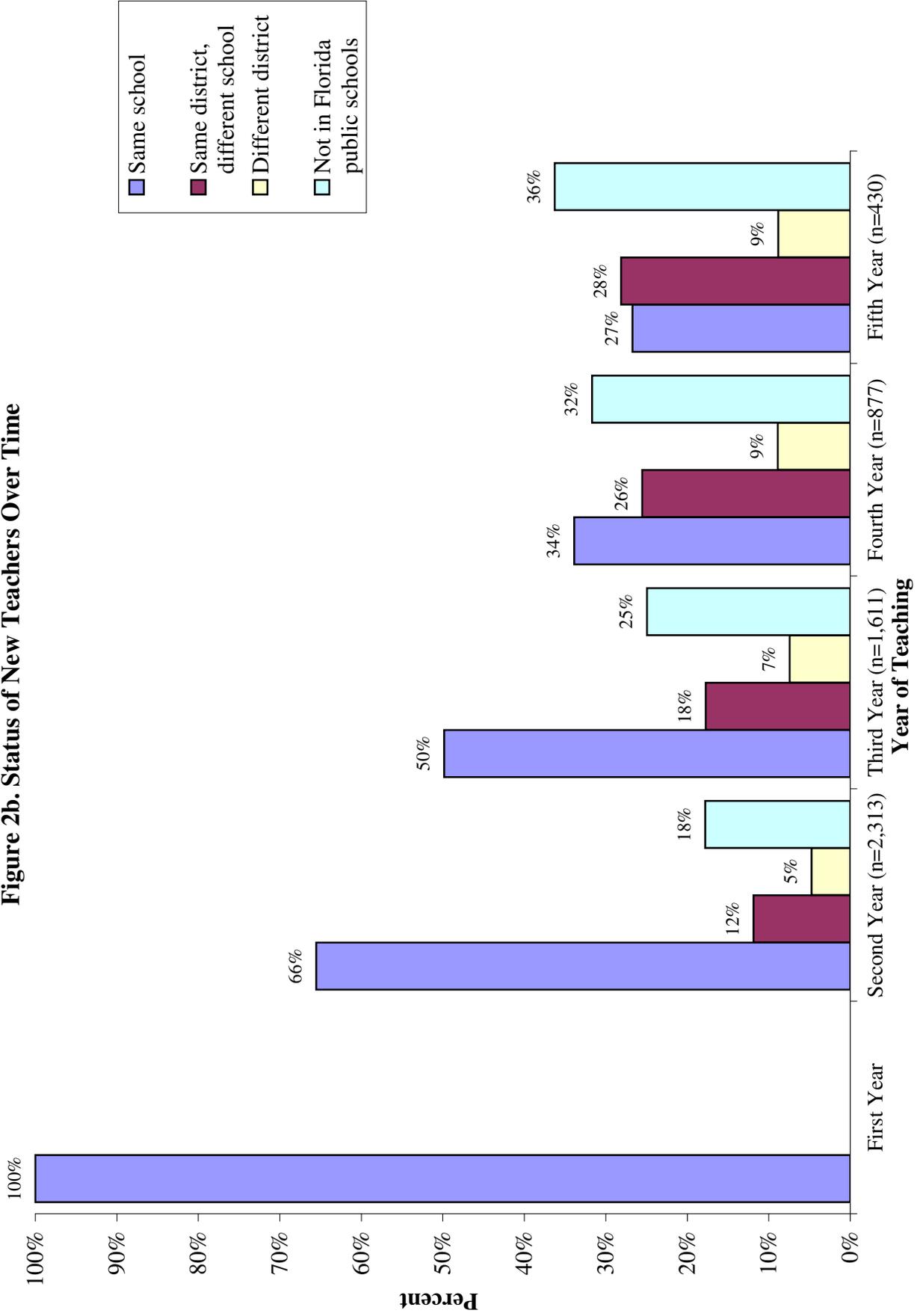
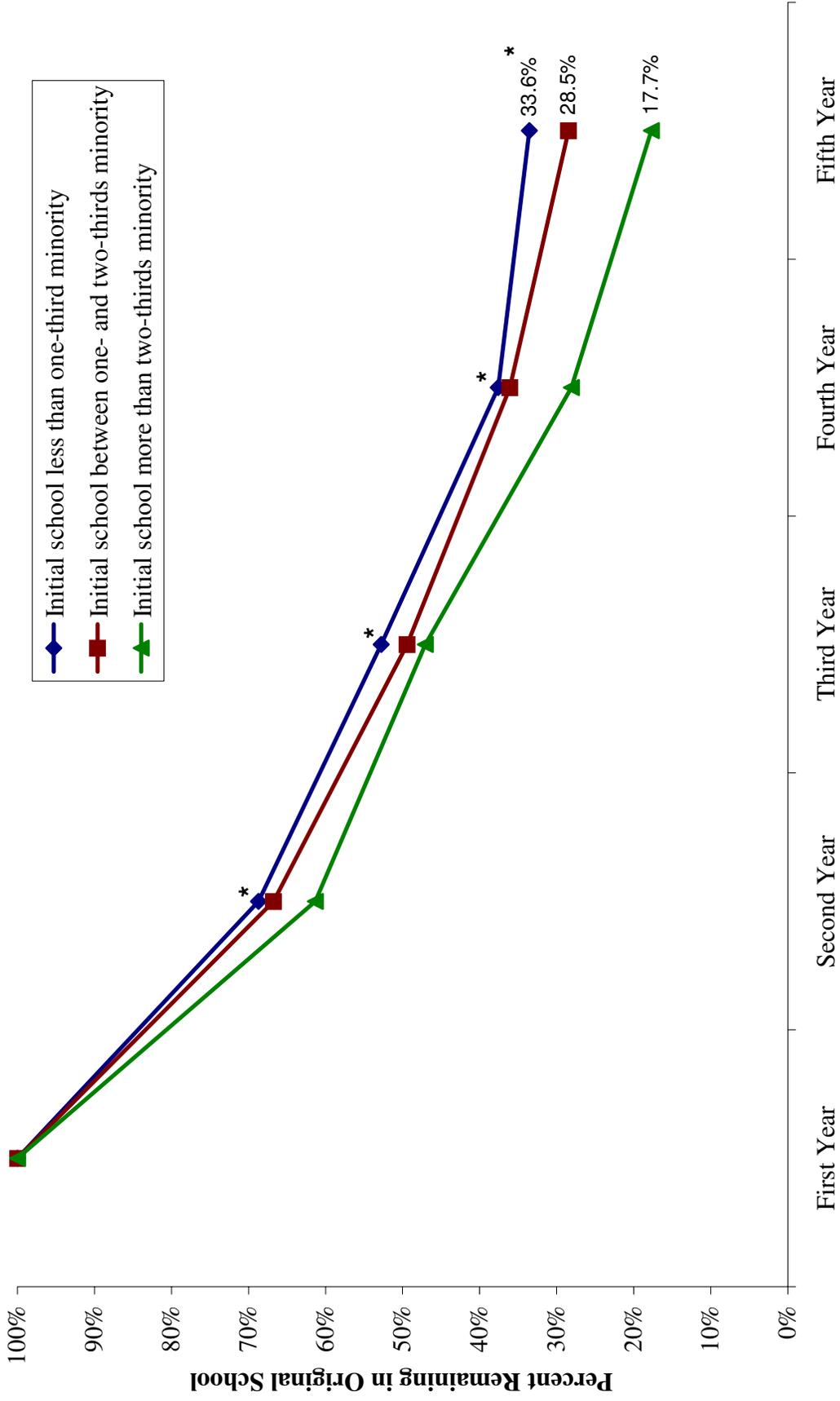
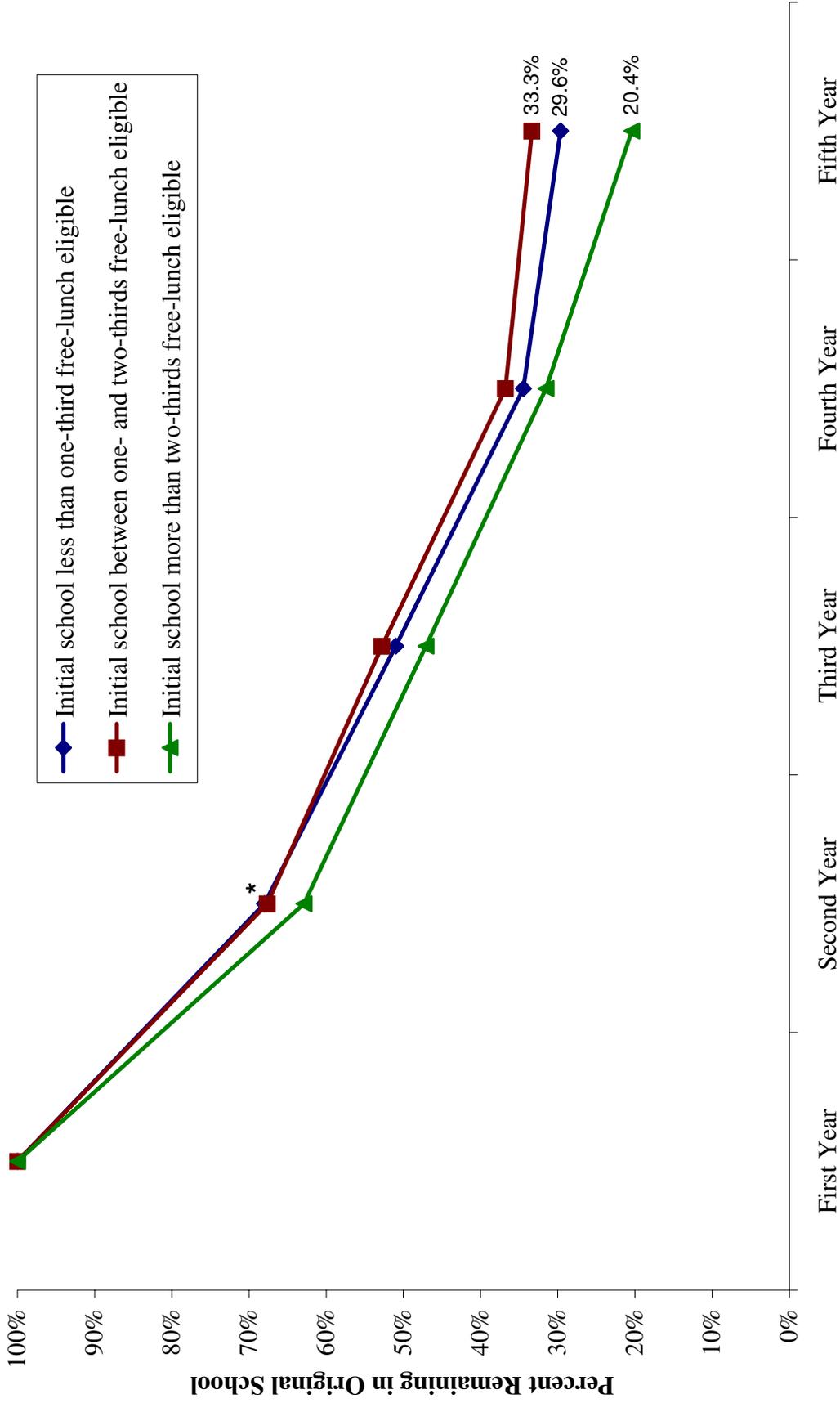


Figure 3. Retention of New 4th- and 5th-Grade Teachers, by School Racial Makeup



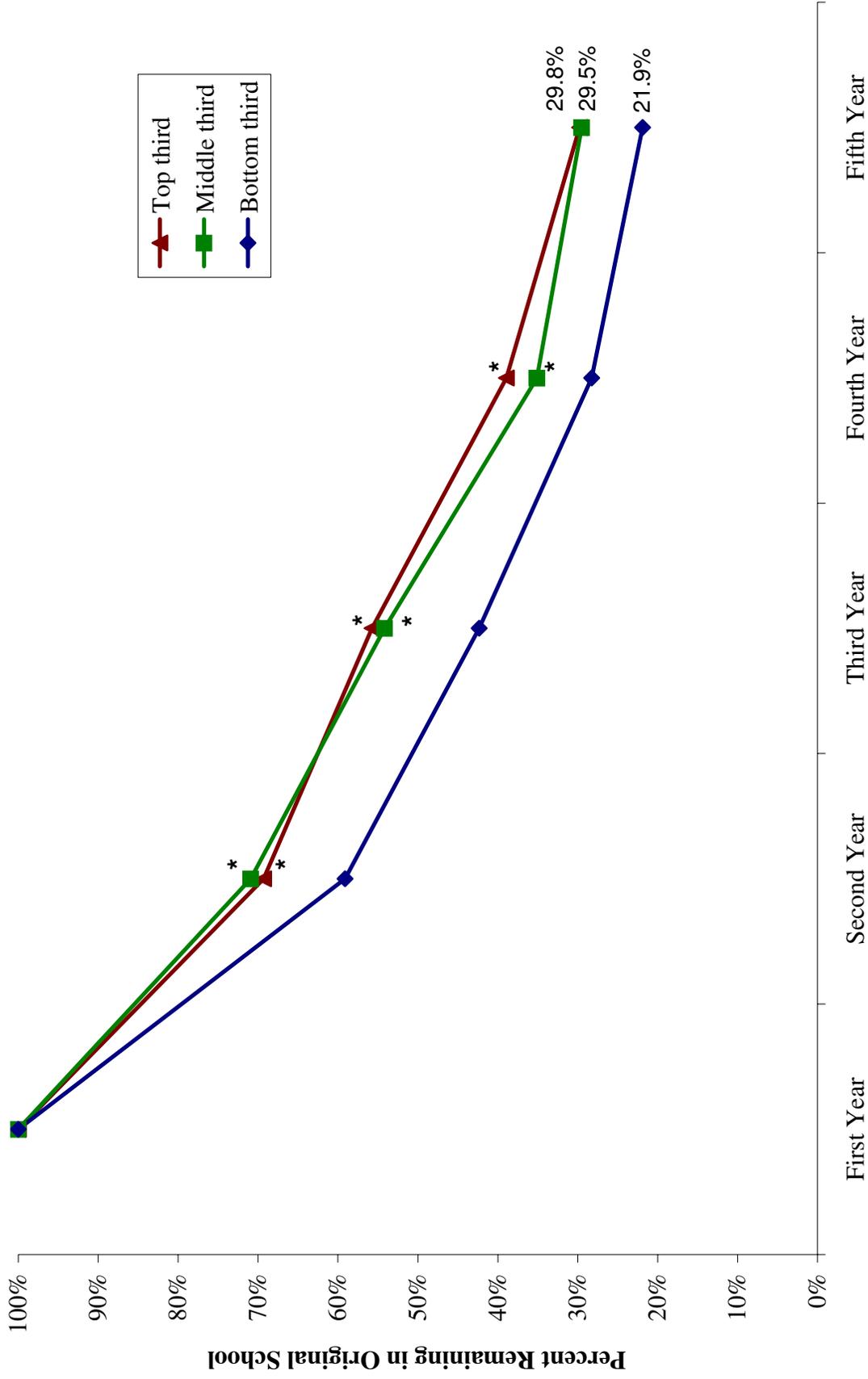
Note: Significant differences (at the 10% level) from the lowest data point in each year indicated by *.

Figure 4. Retention of New 4th- and 5th-Grade Teachers, by School Poverty Rate



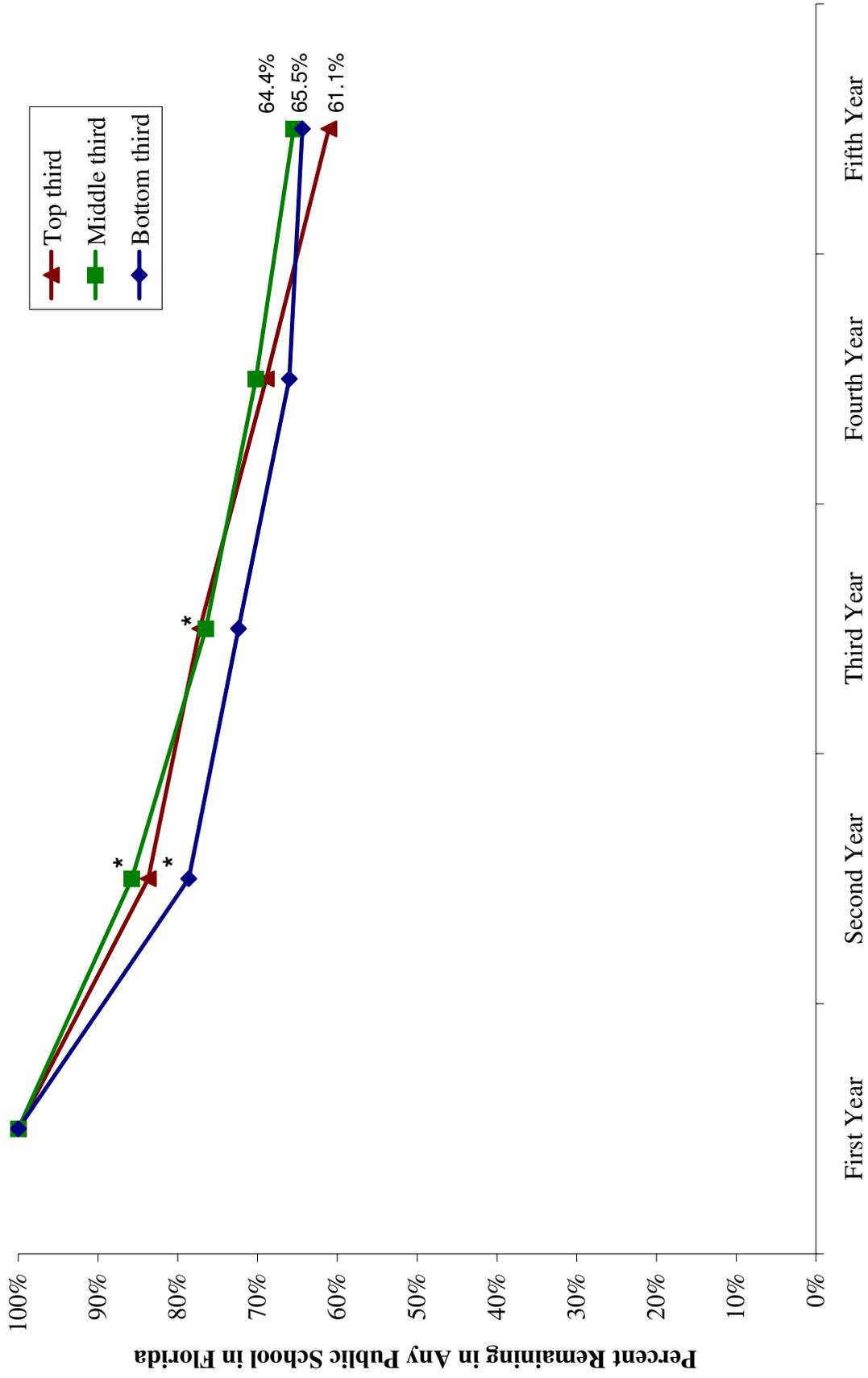
Note: Significant differences (at the 10% level) from the lowest data point in each year indicated by *.

Figure 5. New Teacher Retention in Same School by Effectiveness



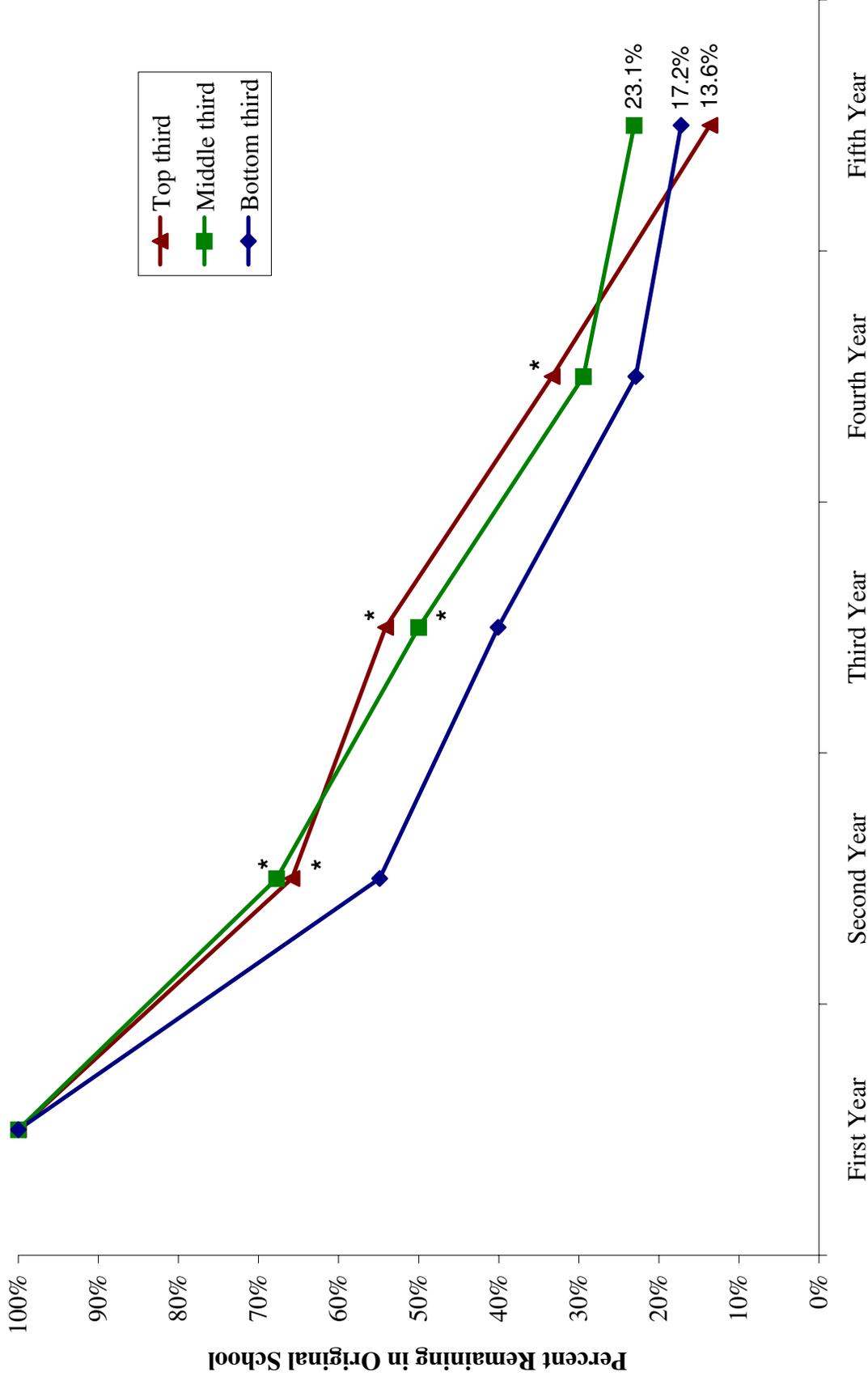
Note: Significant differences (at the 10% level) from the lowest data point in each year indicated by *.

Figure 6. New Teacher Retention in Profession by Effectiveness



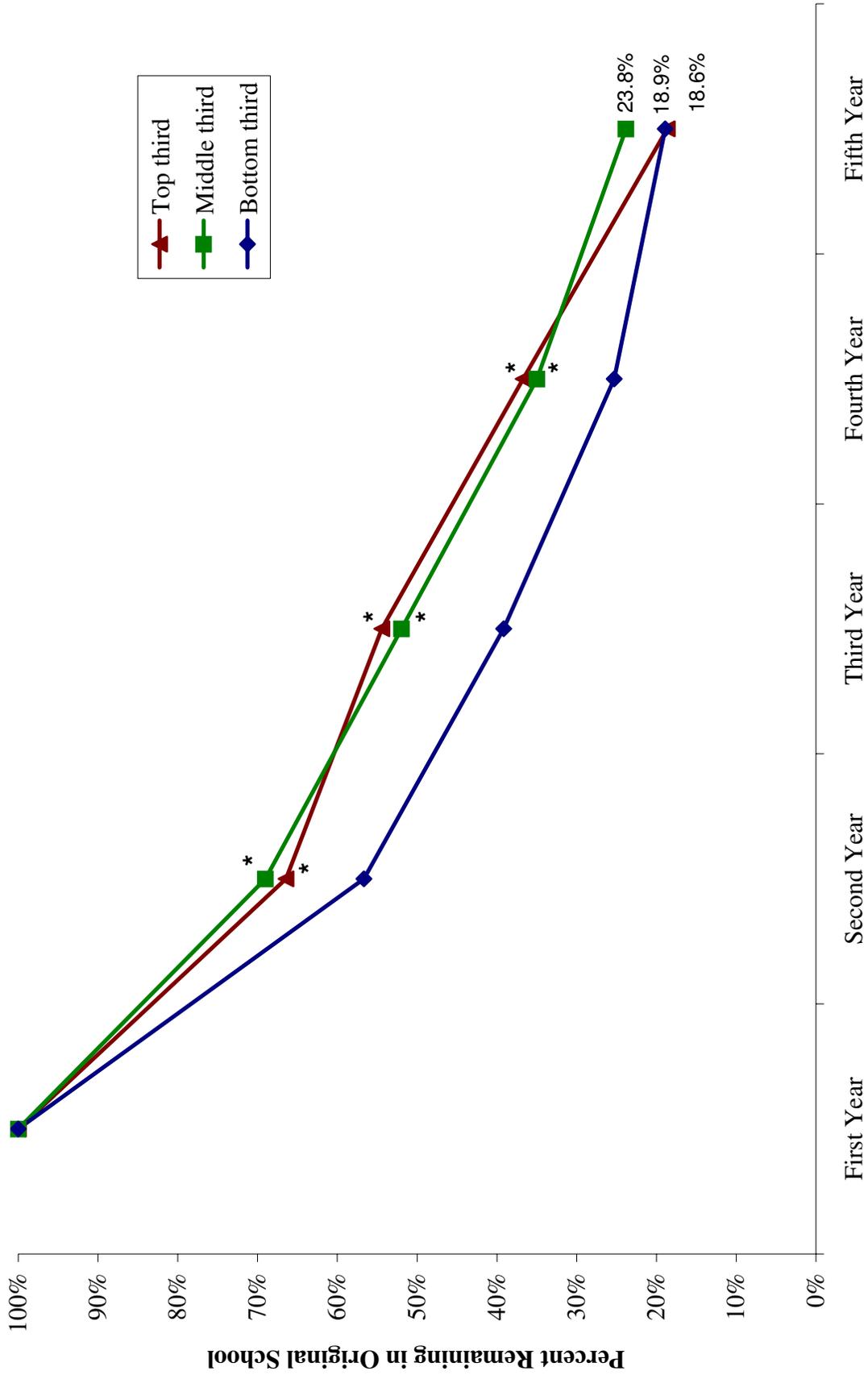
Note: Significant differences (at the 10% level) from the lowest data point in each year indicated by *.

Figure 7a. New Teacher Retention in Same School by Effectiveness, High-Minority Schools



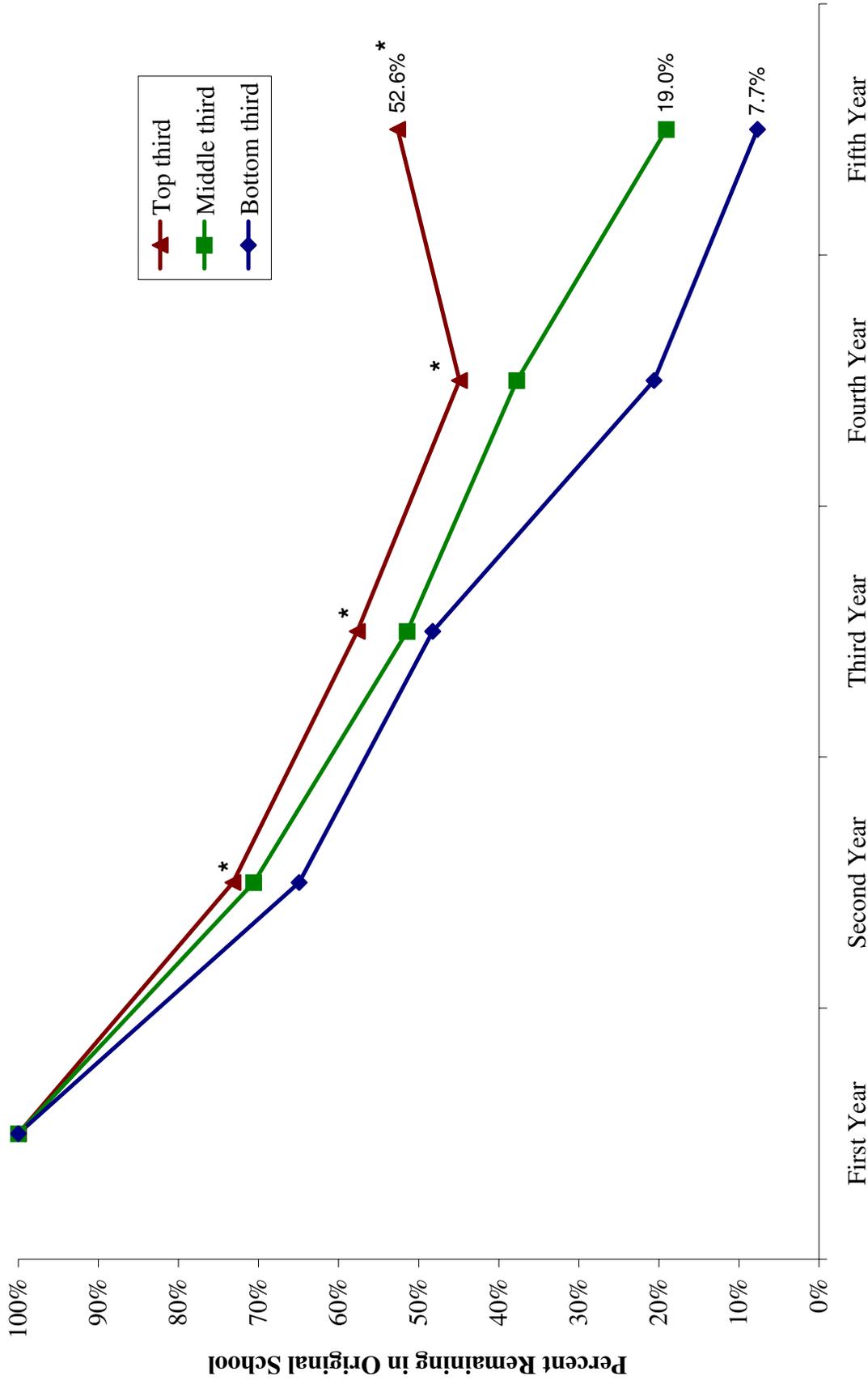
Note: Significant differences (at the 10% level) from the lowest data point in each year indicated by *.

Figure 7b. New Teacher Retention in Same School by Effectiveness, High-Poverty Schools



Note: Significant differences (at the 10% level) from the lowest data point in each year indicated by *.

Figure 7c. Teacher Retention in Same School by Effectiveness, High-Scoring Schools



Note: Significant differences (at the 10% level) from the lowest data point in each year indicated by *.

Table 1. Characteristics of Old and New Schools

	Same District (N=494)				Sig
	Old	New	Δ	%Δ	
Percent Black	32.7%	25.6%	-7.1%	-21.8%	**
Percent Hispanic	23.5%	25.7%	2.2%	9.3%	*
Percent Eligible for Free Lunch	61.3%	53.3%	-7.9%	-12.9%	**
Percent Special Ed	17.2%	16.2%	-1.0%	-5.6%	*
Percent Proficient in Math	50.9%	58.7%	7.7%	15.2%	**
Percent Proficient in Reading	55.8%	61.8%	6.0%	10.7%	**
School Grade	2.83	3.07	0.24	8.5%	**
Base Salary	\$27,418	\$31,396	\$3,978	14.5%	**
	Different District (N=189)				Sig
	Old	New	Δ	%Δ	
Percent Black	35.4%	24.5%	-10.9%	-30.8%	**
Percent Hispanic	17.4%	14.7%	-2.7%	-15.4%	
Percent Eligible for Free Lunch	61.6%	49.0%	-12.6%	-20.5%	**
Percent Special Ed	18.5%	16.4%	-2.1%	-11.6%	**
Percent Proficient in Math	50.6%	61.8%	11.1%	22.0%	**
Percent Proficient in Reading	56.2%	65.2%	9.0%	15.9%	**
School Grade	2.81	3.21	0.40	14.2%	**
Base Salary	\$26,403	\$32,857	\$6,454	24.4%	**

Note: Significance at the 5% (1%) level is indicated by * (**).

Table 2. Characteristics of Old and New Schools, by Effectiveness in Old School

	Bottom Third (N=310)				
	Old	New	Δ	%Δ	Sig
Percent Black	37.9%	27.8%	-10.1%	-26.7%	**
Percent Hispanic	20.9%	21.9%	1.0%	4.7%	
Percent Eligible for Free Lunch	63.3%	54.6%	-8.7%	-13.7%	**
Percent Special Ed	17.9%	16.7%	-1.1%	-6.3%	
Percent Proficient in Math	47.0%	57.1%	10.2%	21.6%	**
Percent Proficient in Reading	52.7%	60.5%	7.8%	14.7%	**
School Grade	2.52	2.96	0.44	17.5%	**
Base Salary (w/n district; n=222)	\$27,293	\$31,226	\$3,933	14.4%	**
Base Salary (b/n district; n=88)	\$25,950	\$33,435	\$7,485	28.8%	**
	Middle Third (N=202)				
	Old	New	Δ	%Δ	Sig
Percent Black	30.7%	24.6%	-6.0%	-19.7%	**
Percent Hispanic	22.7%	22.7%	0.0%	0.0%	
Percent Eligible for Free Lunch	61.0%	52.6%	-8.4%	-13.8%	**
Percent Special Ed	17.7%	16.1%	-1.7%	-9.5%	*
Percent Proficient in Math	52.8%	60.7%	7.9%	14.9%	**
Percent Proficient in Reading	57.7%	64.4%	6.7%	11.5%	**
School Grade	2.98	3.23	0.25	8.5%	*
Base Salary (w/n district; n=146)	\$27,794	\$32,455	\$4,661	16.8%	**
Base Salary (b/n district; n=56)	\$25,775	\$31,907	\$6,133	23.8%	**
	Top Third (N=171)				
	Old	New	Δ	%Δ	Sig
Percent Black	28.6%	21.6%	-7.1%	-24.7%	**
Percent Hispanic	22.5%	24.0%	1.5%	6.8%	
Percent Eligible for Free Lunch	58.4%	47.3%	-11.1%	-19.1%	**
Percent Special Ed	16.8%	15.7%	-1.1%	-6.5%	**
Percent Proficient in Math	55.6%	62.5%	6.9%	12.5%	**
Percent Proficient in Reading	59.6%	64.7%	5.1%	8.6%	**
School Grade	3.19	3.26	0.07	2.3%	
Base Salary (w/n district; n=126)	\$27,185	\$30,419	\$3,234	11.9%	*
Base Salary (b/n district; n=45)	\$28,001	\$32,911	\$4,910	17.5%	**

Notes: Within- and between-district switches pooled for all characteristics except for base salary. Significance at the 5% (1%) level is indicated by * (**).

Figure 8a. Stayers vs. Movers

Year 4

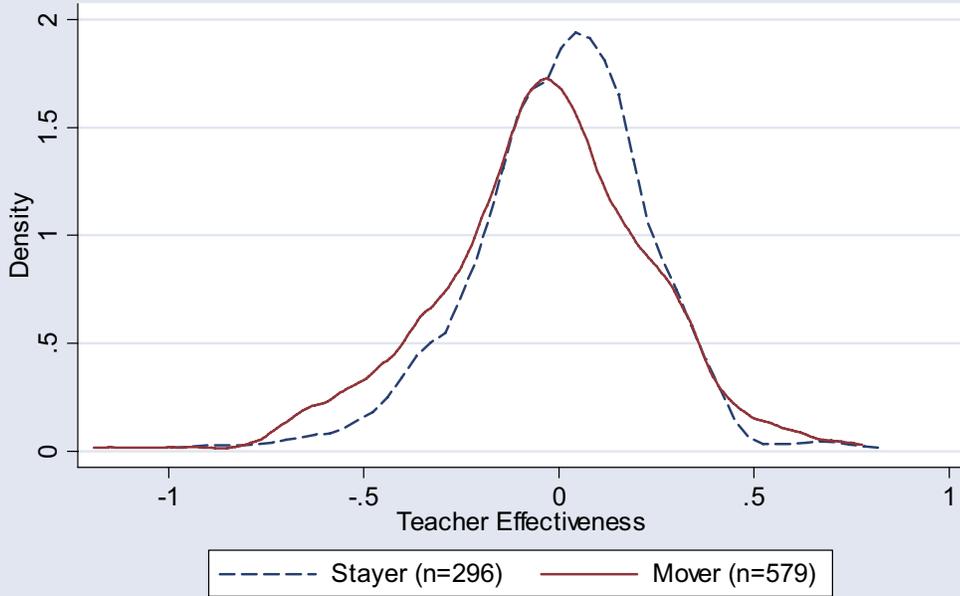
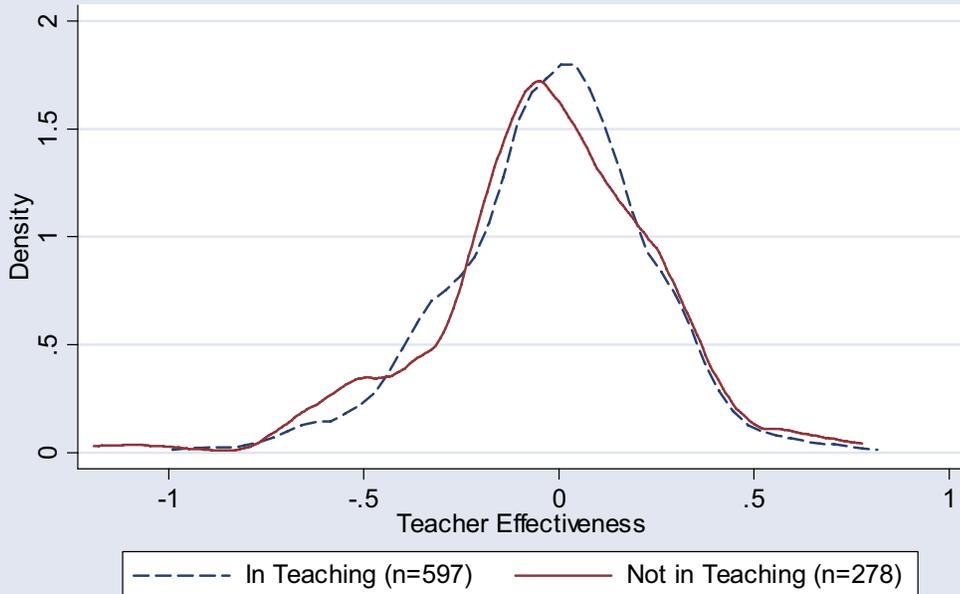


Figure 8b. In Teaching vs. Not in Teaching

Year 4



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