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Estimating Principal Effectiveness

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ABSTRACT

Although much has been written about the importance of school leadership, there is surprisingly little quantitative evidence on the determinants or distribution of principal effectiveness. This paper uses Texas administrative data to generate semi-parametric estimates of principal value-added, describe the distribution of principal effectiveness and principal transition patterns, and examine potential channels through which principals affect school quality including the composition of teacher transitions and student absenteeism. The principal quality estimates reveal larger variation in principal quality in higher poverty schools, while the analysis of transition patterns reveals little systematic evidence of higher transition rates for more effective principals, particularly in high poverty schools. Finally, evidence of lower student absenteeism and more negative selection of exiting teachers in schools with higher value-added principals support the view that the principal fixed effects capture real quality differences.

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I. Introduction

School leadership is frequently described as the key element of a high-quality school, and stories of the inspirational and effective principal are plentiful and oft-repeated.[2] However, it is by no means clear that market forces related to the choice of neighborhood and school provide strong incentives for principals to act in ways that foster highly effective schools. Rothstein (2006) discusses a number of possible impediments to such market forces and reports evidence consistent with absence of strong demand for effective schools. School accountability does provide an alternative and more direct incentive structure for schools and administrators that could potentially remedy information failures and strengthen market forces pushing effective schools. The potential effectiveness of accountability depends in part on the responsiveness and quality of principals. Unfortunately, little systematic evidence on the distribution of principal effectiveness exists, making it difficult to sort through alternative policy proposals.

Cullen and Mazzeo (2007) investigates the link between principal salary growth and employment transitions on the one hand and principal effectiveness as measured by state accountability rating, achievement, and productivity on the other using Texas administrative data. It finds a positive relationship between salary and both accountability

[2] A large qualitative literature focuses on "effective schools" and in that generally places special emphasis on principals and leadership issues. See, for example, Edmonds (1979), Purkey and Smith (1983), or the case studies in Carter (2000).

rating and student achievement. In addition, it finds that principals of more highly rated and higher achieving schools are more likely to persist in their current positions.

These results suggest that a higher accountability rating and higher achievement raises salary and job security, but the possible influences of confounding factors including peer composition suggest caution in the interpretation of the findings. Specifically, the limited set of student, school, and district controls leaves open the possibility student achievement may not provide a meaningful measure of principal effectiveness because of the contributions of unobserved student, family and school factors. It may also be the case that unobserved factors such as family wealth or commitment to education raise both student performance and principal pay, and that the observed relationship between the two does not capture a causal effect. However, the fact that school switchers realize the largest salary increases does suggest that the accountability rating and student achievement do improve labor market outcomes for principals.

We take a somewhat different approach in our efforts to identify the variation in principal effectiveness and factors that contribute to that variation. Specifically, we estimate principal effectiveness based on average annual value added to student mathematics test scores.[3] In order to avoid complications introduced by differences in tenure, the samples are limited to observations from the first two or three years of a principal's tenure at a school. Shrinkage methods are also used to mitigate the influences

[3] Brewer (1993) and Eberts and Stone (1988) also use panel data to control for student differences by adopting value-added specifications. These studies find evidence that principal quality positively affects achievement, but the possibility that unobserved student or school level characteristics introduce bias remains.

of test error, and some specifications include school fixed effects to account for unobserved school differences that could contaminate the estimates.

We use the estimates of principal quality to describe the distribution of principal effectiveness by school poverty rate and also by principal transition status. Systematic differences by poverty rate may derive either from differences in the underlying distributions of principal quality or differences in the magnitude of the effect of principal quality on student outcomes. From case studies and anecdotal accounts, the importance of principals seems most apparent when considering schools serving disadvantaged populations. The demands of schools with poor-performing students including their more difficult working conditions and added difficulty attracting and retaining teachers may inflate the importance of having an effective leader as compared to the situation in a higher achieving school.[4] Moreover, higher quality principals may be more likely to transition out of high poverty schools, and we also describe average effectiveness for stayers and movers by poverty rate to learn more about the dynamics of the principal labor market.

Following the description of the distribution of principal value added we investigate the relationship between principal quality on the one hand and teacher transitions and student attendance on the other. If estimates of principal quality actually capture differences in principal effectiveness as opposed to other confounding influences one would expect to find improvements in teacher quality and a decline in student absenteeism during the first two or three years at a school. Because high teacher turnover is associated with both improvement and decline in the quality of instruction, the level of turnover provides little information on the wisdom of principal personnel decisions.

[4] Hanushek and Rivkin (2007)

Given that principals often exert little control in the hiring process, we focus on the relationship between the quality of teachers who transition out of a school and the quality of principals. By not rehiring less effective teachers, encouraging them to leave or retaining effective teachers, a successful principal can improve the stock of teachers over time. In contrast, a principal that alienates the more effective teachers may lower the quality of instruction.

We would also expect effective principals to improve student behavior. Discipline data are limited both in terms of the number of years and the absence of information on underlying behavior. Therefore we focus on attendance information and estimate the relationship between principal quality and absenteeism.

The next section of the paper describes the data, and Section 3 presents a description of the distribution of principals by experience, tenure, and student demographic composition. Section 4 provides a conceptual framework for the consideration of principal effectiveness. Section 5 discusses the empirical framework used to measure principal effectiveness and reports our findings on the distribution of principal quality including differences by student demographic composition. The analysis pays particular attention to problems introduced by test measurement error and differences in student characteristics among schools. This section also describes principal quality differences by transition status. As is the case for teachers, the consequence of principal turnover depends in large part on the difference in quality between the departing and entering administrators. Section 6 investigates the relationship between estimates of principal effectiveness on the one hand and the quality of departing teachers and student

absenteeism on the other. Section 7 summarizes the findings and considers implications for policy.

II. The Texas Database

The administrative data used in this project were constructed as part of the UTD Texas Schools Project. Working with the Texas Education Agency (TEA), this project has combined different data sources to create matched panel data sets of students and teachers. The panels include all Texas public school teachers, administrators, staff, and students in each year, permitting accurate descriptions of the schools for each principal.

The Public Education Information Management System (PEIMS), TEA's statewide educational database, reports key demographic data including race, ethnicity, and gender for students and school personnel as well as student eligibility for a subsidized lunch. PEIMS also contains detailed annual information on teacher and administrator experience, salary, education, class size, grade, population served, and subject. Importantly, this database can be merged with information on student achievement by campus, grade, and year. Beginning in 1993, the Texas Assessment of Academic Skills (TAAS) was administered each spring to eligible students enrolled in grades three through eight.[5] These criterion referenced tests, which assess student mastery of grade-specific subject matter, are merged with the student and personnel information. Reading and math tests each contain approximately 50 questions, although the number of questions and average percent correctly answered varies across time and

[5] Many special education and limited English proficient students are exempted from the tests. In each year roughly 15 percent of students do not take the tests, either because of an exemption or because of repeated absences on testing days.

grades. We transform all test results into standardized scores with a mean of zero and variance equal to one for each grade and year. Thus, our achievement measures describe students in terms of their relative position in the overall state performance distribution.

Because the years of experience in the Texas public schools variable combines both time as a teacher and as an administrator, it is not possible to measure tenure as a principal accurately for those who begin their principal career prior to 1990/91 school year, the initial year of our personnel data. Therefore, for both the descriptive analysis and the achievement modeling we concentrate on the period 1995-2001, and we allocate principals to precise experience and tenure categories in the early career while aggregating experience for six or more years.

III. Distribution of Principals

This section describes the distribution of principals by demographic characteristics, tenure, and student income, race, ethnicity, and achievement using data for school years 1995 to 2002. This descriptive information forms the backdrop from which to examine principal effectiveness and differences by student characteristics.

Table 1 describes trends over time in the share of all principals and first year principals who are female, black, and Hispanic respectively. Although the shares of each of these groups increase between 1995 and 2002, women show the largest percentage point gains. In 1995 roughly 53 percent of all elementary and middle school principals were women, and that increased to 62 percent by 2002. While slightly more than half of the new principals were women in 1995, almost two thirds of the entering principals were women in 2002. The shares of black and Hispanic principals also increased by more than

10 percent during this period. Between 1995 and 2002 the black principal share increased from 9.8 to 11.2 percent, while the Hispanic principal share rose from 18 percent to 20.5 percent. It appears that growth in enrollment and the number of schools and principals contributed to increases in the shares of principals who are female, black and Hispanic.

Table 2 describes differences in tenure at the current school by student income, race-ethnicity, and quartile of the mathematics test score distribution. Schools are divided into quartiles on the basis of enrollment shares for each of these characteristics, and the proportions of principals with one, two, three, four, five and six or more years of tenure are reported. Note that the relatively short time frame of the sample prevents additional detail beyond six years, as even the experience variable reported in the administrative data combines years as a principal with years spent in other roles including teacher.

Although high proportion low income schools are more likely than low proportion low income schools to have first year principals and less likely to have principals who have been at the school at least six years, the division of schools by initial achievement produces much larger differences. The proportion of principals in their first year in schools with the lowest average initial achievement is roughly 40 percent higher than in schools with the highest average initial achievement, while the proportion of principals that have been at their current school at least six years is roughly 50 percent higher in the highest achievement schools. Similar differences are smaller when schools are ordered by income and far smaller when schools are ordered by black or Hispanic enrollment shares. The extent to which this captures the duel impacts of factors on achievement and principal turnover or the higher turnover of ineffective principals is not clear.

Table 3 reports principal transitions categorized by destination, new role, and tenure. Roughly 70 percent of principals remain principals in the same school for the subsequent year regardless of tenure. The probability of changing schools and remaining a principal rises from 5.9 percent following the first year at a school to 8.3 percent following the third though fifth years prior to falling back to 5.7 percent for those with tenures of at least six years. By comparison, the probability of transitioning to a non-principal role at a campus declines from 4.5 percent to 2.8 percent as tenure increases from one to at least six years. For those with at least two years of tenure approximately 2 percent transition to work as district administrators. Finally, between 1 in 5 and 1 in 6 principals exit the Texas public schools entirely regardless of tenure category. Note that limiting the sample to principals with no more than 25 years of experience in order to lessen the contribution of retirements has little impact on these patterns.

IV. Estimation of Principal Effectiveness

Separation of the impact of principals on student achievement from the contributions of various student, school, and district characteristics is complicated by the fact that those factors contributing to achievement likely also make the school more desirable for the typical applicant for a principal position. Given the difficulty of accounting for all such factors, we use lagged test score to account for student heterogeneity and measure principal quality on the basis of average annual value-added to achievement. In some specifications we also include school fixed effects in order to account remaining unobserved school differences. Because of the small number of schools for which we observe two different principals in their first three years at the

school, the fixed effect analysis does not limit the sample to principals in their first three years.

The impact of a principal on school quality likely increases with tenure, and comparisons among principals should account for differences in length of service at a school. Importantly, the impact may become more positive or more negative over time, so simple linear or polynomial controls for tenure are not appropriate. On the one hand, over time a principal would be expected to learn about school operations, the effectiveness of various teachers, and other school specific factors, and such learning would presumably improve job performance. On the other hand, however, principal personnel decisions alter the stock of teachers and the school environment, and the impact of a principal increases over time as a principal accounts for more and more of the hiring and retention of the existing stock of teachers. Therefore we restrict samples to a principal's first three years (sometimes first two years) in a school.

Importantly, this restriction is not feasible in school fixed effects models that identify principal effectiveness on the basis of within school achievement differences. Therefore in these models we expand the sample to include all observations with the exception of a principal's first year in a school. A substantial share of the sample includes longer-term principal spells that began prior to the sample frame, and given the learning that takes place during the first year and strong influence of the prior administration we omit the first year in order to make comparisons among principals more meaningful.

Test measurement issues also complicate the estimation of principal quality, and we consider both measurement error and the possibility that a focus on basic skills

disadvantages principals in schools with larger shares of high achieving students. Below we describe steps taken to address these concerns in the empirical analysis.

A. Empirical Model

Our basic models relate achievement (A) for student i in school s with principal p in year y as a function of prior achievement, observed student characteristics (X), time varying school and peer characteristics (C), and a vector of principal by school fixed effects. Adding a random error (ε), the empirical model is:

$$(1) \qquad A_{ispy} = \lambda A_{i,y-1} + \beta X_{isy} + \delta C_{sy} + \theta_p + \varepsilon_{ispy}$$

The vector X includes a full set of race/ethnicity indicators and indicators for subsidized lunch eligibility, special education participation, female and English as a second language classification, a switch to the earliest grade offered in a different school (including structural transitions from elementary to middle school), and a switch to other than the earliest grade offered in a new school; and the vector C includes average demographic characteristics for students in school s in year y including proportion low income, proportion classified as special needs, proportion that are recent immigrants and proportion female. All regressions also include a full set of year-by-grade indicators to account for test changes and other statewide policy changes.[6]

The key identifying assumption is that there are no unobserved student, community, or school factors not caused by the principal that are related to θ. Given the

[6] Prior to running the regressions, the data are aggregated to the campus by grade-by-year level to reduce the computational burden. All tables report absolute values of t-statistics based on robust standard errors clustered by campus.

limited demographic information available, the validity of the basic model hinges on the assumption that lagged achievement soaks up all confounding factors. This is a strong assumption given the difficulty of separating principal effects from other school influences not caused by the principal. Even the inclusion of school fixed effects does not account for confounding factors if they vary over time.

Therefore in the next section we investigate the relationship between estimates of principal quality and factors expected to be influenced by principals including teacher quality and student attendance in order to provide additional evidence as to whether the principal fixed effects capture differences in effectiveness or simply reflect underlying variation in other determinants of achievement.

B. Test Measurement Issues

Given the substantial variation in both enrollment and student demographic characteristics among schools, test error and the structure of tests potentially complicate the measurement of principal quality. Measurement error in the estimation of principal fixed effects is likely to vary inversely with enrollment, and differences in the underlying distribution of student achievement may affect the translation of principal quality into student achievement. For example, in schools where many students would score near the top at the beginning of the school year, principal quality could have very little effect on standardized test scores even if it is having substantial impact on the overall level of intellectual engagement and quality of instruction.

Measurement error in the principal fixed effect estimates clearly must be addressed. As Kane and Staiger (2002) and Jacob and Lefgren (2005, 2006) point out, even in the absence of confounding influences quality estimates capture both random

error and true effects. Consequently variance estimates overstate the actual variation in principal effectiveness, and the magnitude of any upward bias is likely to increase as school size decreases. Following Morrison (1983) we utilize a shrinkage estimator to mitigate the impact of the test error. Normalizing average principal quality to zero, the adjusted quality estimate $\hat{\eta}_s^a$ for principal s in year y equals

$$\hat{\eta}_{sy}^a = \frac{V_{sy}}{V_{sy} + A}\hat{\eta}_{sy}$$

where $\hat{\eta}_{sy}$ is the coefficient on the principal s dummy variable in year y, V_{sy} is the estimated variance of that estimate, and A is the estimated variance of the principal by spell fixed effect distribution. Essentially, the larger the fixed effect error variance for a principal spell the more the adjusted fixed effect is shrunk toward the grand mean.

A related but clearly separate issue concerns the possibility that differences in the underlying distribution of student achievement alter the translation of principal quality into student achievement. For example, principal efforts may have little effect on the TAAS scores of high achieving students who could do very well on this test focused on lower level skills even without attending school. Consequently our test score based estimates of principal quality may produce a more compressed distribution for groups of schools with higher shares of initially high achieving students. Because we are particularly interested in the possibility that principals may have larger effects in schools serving predominantly disadvantaged students who tend to have lower initial scores, this concern must be addressed in order to produce valid comparisons across schools grouped by poverty rate.

We use two alternative methods to investigate the sensitivity of the estimates to student composition. The first includes a more flexible specification of prior achievement in order to capture differences in expected test score growth by initial score. Although this likely mitigates the problem, even the inclusion of quadratic or cubic terms may not fully address the problem given the skewness of the test score distribution. Therefore our preferred method is to weight observations in all schools and years with fixed weights in order to produce estimates of principal quality not influenced by differences in the test score distribution among schools.

Equation 2 shows the calculation used to produce weighted school by grade by year mean test score:

$$\overline{A}_{sgy} = \frac{1}{N_{sgy}} \sum_{i=1}^{10} \sum_{c=1}^{N_{sgyi}} \frac{F_i}{share_{sgyi}} A_{csgyi}$$

Where F_i is the fixed weight share for decile i, $share_{sgyi}$ is the actual share of students in school s in grade g in year y in decile i, N is enrollment, A is test score, and c indexes child. The weights come from the distribution of 3rd grade mathematics achievement scores in 1994 for students in the top quartile of schools in terms of proportion of students eligible for a subsidized lunch. F_1 is the share in the bottom test score decile, F_2 in the second decile, and on up to F_{10} in the top decile. The scores of students at the low end of the distribution receive disproportionate weight in schools with small shares of such students relative to the weighting sample of higher poverty schools, while the scores of such students receive less than proportional weight in schools with a high concentration of initially low achieving students.

V. Differences in Principal Effectiveness

This section examines the variation in principal effectiveness as measured by value-added to mathematics achievement. The first part reports estimates of the variation in principal effectiveness for the the sample of principals in their first three years in a school. Following the presentation of the basic value-added estimates we examine the sensitivity of the observed patterns to shrinking the estimates in order to account for test measurement error and re-weighting the data to account for underlying differences in the achievement distribution among schools. The second part uses the expanded sample and investigates the impact of including school fixed effects on estimates of the variation in principal effectiveness. These fixed effects remove all between school differences, leaving only within school differences to contribute to the variation in principal effectiveness. Finally, the third part describes differences in quality by principal transition status following the third year in a school for the sample of principals in their first three years in the school.

The analysis focuses on differences in the distribution of principal effectiveness by school demographic composition. Such differences receive considerable attention, and we describe the variation in effectiveness by quartile of the share of students eligible for a subsidized lunch. Because high poverty, high student turnover schools may confront more difficulties in attracting and retaining teachers and in maintaining discipline, it would not be surprising if principal quality were to have a larger effect in on outcomes in such schools. In addition, underlying differences in the distribution of principal quality may also contribute to any observed variation in principal added.

Note that what we refer to as principal value added is actually average annual school value added during the first three years of a principal's tenure. The interpretation

of these semi-parametric estimates as principal effects requires strong assumptions about the efficacy of the model in accounting for confounding factors and about the importance of principals in many aspects of school operations. Below we provide evidence that the pattern of these estimates conforms to other information in ways that support the belief that they capture differences in principal effectiveness.

IVa. Baseline analysis

The analysis of the sample of the first three years of a principal's tenure in a school begins with estimates from a basic value added model before presenting results from Bayesian shrinkage estimators and data reweighted to make the initial test score distribution comparable across schools. Table 4 reports the mean, variance and 10^{th}, 25^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles of the principal by spell fixed effect distribution by the school poverty rate based on a sample of the first three years at a school. Going down the rows reveals monotonic relationships between the poverty rate on the one hand, and the mean and variance on the other. Specifically, the mean principal by spell fixed effect declines but the variance increases with the poverty share. An examination of the various quantiles shows that the increase in dispersion as the poverty level rises is most pronounced at the lower end of the distribution: The difference between the top and bottom poverty rate quantiles equals -0.20 standard deviations at the 10^{th} percentile, -0.17 standard deviations at the 25^{th} percentile but only 0.07 standard deviations at the 90^{th} percentile.

Test measurement error and school differences in the skill distribution may not only inflate the variance estimates but also affect the pattern of estimated principal fixed

effects by school poverty share given the association between poverty and achievement. Table 5 presents three sets of estimates that address these two issues separately and then together. The top panel contains information based on the estimates summarized in Table 4 but shrunk to the grand mean on the basis of the standard errors; the second panel reports the mean, variance, and quantiles for estimates of principal fixed effects based on value added estimates of reweighted data that eliminate differences in the distribution of initial achievement among principals; finally, the bottom panel reports results based on reweighted data that have been shrunk to remove the effects of test error.

The very close similarity between the results in the top panel and those in Table 4 and between the results in the bottom two panels of Table 5 show that shrinkage has virtually no effect on the estimated distribution of principal quality. Unlike estimates of teacher value added that often rely on fewer than 50 observations for many teachers, estimated value added for principals of even quite small schools typically come from at least several hundred test scores. Consequently the variance of the error is likely to be quite small, and it is not surprising that shrinkage has little effect on the results.

In contrast, there are marked differences among schools in the initial achievement distribution, and this raises the possibility that the greater concentration of test scores at the lower end of the achievement distribution causes the larger variance in principal quality observed for high poverty schools. Re-weighting the scores such that the estimates for all principals are based on the same underlying distribution among test score deciles mitigates this concern. However, it does potentially increase the error variance by placing greater weight on smaller cells, and this may have a particularly large effect in very high and very low poverty schools.

Both the middle and bottom panels report results based on the reweighted data, and these show a similar pattern of larger dispersion in higher poverty schools. Consistent with the notion that re-weighting increases the error variance, the use of the shrinkage estimator has a much larger effect on the re-weighted data.

IVc. School Fixed Effect Estimates

The baselin estimates show substantial variation in principal effects on value-added, but questions remain as to whether unobserved factors confound these estimates. In order to mitigate bias from confounding factors we add school fixed effects to the value added model and estimate the variation in principal quality over the expanded sample that includes information for all principal spells other than the first year in a spell. Because of differences in principal tenure and sample composition we would expect the variation in principal effectiveness to be larger in the expanded sample, and therefore we include estimates for the baseline value added model as well as for the model that includes school fixed effects.

As expected Table 6 shows that the inclusion of the school fixed effects substantially reduces the variation in principal quality, and the variance in the baseline value added model is slightly larger in the expanded than in the three year spell sample. In both the separate poverty categories and for the sample taken as a whole the inclusion of school fixed effects reduces the estimated variance of principal quality by more than 75 percent and the 75-25 and 90-10 differentials by more than 50 percent.

Interestingly, estimated principal quality variance of 0.012 from the school fixed effect model is quite similar in magnitude to within school estimates of the variance in teacher quality (Hanushek and Rivkin, JEP?). A variance of 0.012 implies a standard

deviation of roughly 0.1, meaning that a one standard deviation improvement in principal quality is associated with a 0.1 increase in test scores. Because this effect cumulates over time the estimates reveal sizeable variation in principal effectiveness within schools. The possibility remains, however, that confounding factors might account for a portion of the observed variation in school average value added. Therefore in the next section we investigate the relationship between our estimates of principal quality and other outcomes that should be related to these measures if in fact they capture real quality differences.

IVc. Differences by Transition

Many bemoan high rates of teacher and administrator turnover in high poverty schools, but the magnitude of the problem depends in large part on which principals are leaving. In order to gain a better understanding of this issue, we describe principal transitions following their third year in a school by principal quality and the share of students eligible for a subsidized lunch. Principals may remain in the same school as principal, remain in the same school in another capacity, take a principal position in another school, take a different position in another school, move to a central administrative position, or exit the public schools entirely. The principal quality measures are based on un-weighted data for principals with fewer than 25 years of experience in order to minimize complications introduced by the retirement decision. Note that the experience restriction has virtually no effect on the transition patterns.

Table 7 shows that with the exception of the lowest poverty schools there is not a monotonically increasing relationship between the probability of remaining in the same position and principal quality. Rather principals in the 2nd quartile are substantially more likely to remain than those in the bottom quartile, the differential between those in the 2nd

and 3rd quartiles tends to be somewhat smaller (or almost zero for those in the highest poverty schools), and the most effective principals are actually less likely to remain in the same position than those in the 3rd quality quartile. In general, the probability of exiting the public schools entirely moves as the mirror image of the probability of remaining in the same position.

A troubling aspect of Table 7 is the substantial share of low performing principals who transition to principal positions at other schools. This is particularly striking in the two highest poverty categories where over 12% of poor performers make such a move. In contrast, less than 7% of the poorest performers in the two lower poverty categories become principals at other schools.

Another interesting aspect of Table 7 is the fact that more effective principals tend to be less likely to move into central administrative positions. This is particularly the case in higher poverty schools, where some districts may be using central administrative slots as a means to keep ineffective principals out of schools.

VI. Teacher Quality, Student Attendance and Principal Effectiveness

We interpret average annual value added as a measure of principal effectiveness, but absent direct evidence on principal actions such an interpretation is tenuous and open to criticism. In order to provide additional evidence and understand better the channels through which principals affect achievement we now consider the relationship between principal quality and two oft-discussed mechanisms through which principals are thought to affect school quality: the quality of the stock of teachers and student attendance. We

focus on the quality of departing teachers because principals often have little information on or control over the quality of new entrants.

VIa. Quality of departing teachers

A primary channel through which principals can improve the quality of education tyis by raising the quality of teachers either through improved instruction by existing teachers are teacher turnover. Because it is difficult to separate improvement in the quality of instruction by current teachers from other changes that raise achievement, we focus on teacher turnover. Specifically, we would expect highly rated principals to be more succesful at retaining the more effective teachers and moving out the less effective teachers. In contrast, we would expect less highly rated principals to be less successful in raising the quality of the teaching stock, because of less skill in evaluating teacher quality, less emphasis on teacher effectiveness in personnel decisions, or less success at creating an environment that is attractive for better teachers. If this is the case adverse selection of teachers asked not to return should be stronger in schools with higher quality principals.

However, teachers clearly initiate many transitions out of schools, and the data do not distinguish between voluntary moves that are unrelated to the behavior of the principal and transitions influenced by principal actions. In addition, the data do not match students and teachers, meaning that we must draw inferences about teacher quality from grade average information. This avoids problems introduced by non-random assignment to classrooms that potentially biases estimates of teacher value added (See Rothstein 2009), but it prevents direct comparisons of the quality of stayers and leavers.

Consequently, our description of the relationship between estimates of the quality of exiting teachers and their principals is fairly rough.

Consider an elementary school with four teachers each in grades 4 and 5, some of whom are dismissed. With accurate measures of teacher effectiveness and information on dismissals we could investigate whether better principals are more likely to dismiss the least effective teachers. In the absence of such information, however, we focus on the relationship between the share of teachers in a grade that exit and grade average value-added within schools. Specifically we investigate whether the relationship between the teacher exit rate in a grade and grade average value added is more negative in schools with higher quality principals. This is quite a rough test of whether principals are dismissing their least effective teachers, as small grade average differences in mean value-added provide little information on the probability that there is a very low performing teacher in one grade as opposed to another. Thus there may be many circumstances in which the lowest performer teaches in the grade with the highest average teacher quality, and our approach would provide a misleading measure of whether the principal is dismissing the least effective teacher in these cases.

Equation (2) presents the model used to investigate the relationship between the effectiveness of exiting teachers and principal quality. Here average achievement (A) in grade g in school s in year y is a function of prior achievement, observed student characteristics (X), school and peer characteristics (C), the teacher exit rate following year y (T), T interacted with indicators for the 2nd, 3rd, and 4th quartiles of estimated principal quality (Q_i) and a vector of campus by year fixed effects.

$$\bar{A}_{gsy} = \lambda \bar{A}_{gs,y-1} + \beta \bar{X}_{gsy} + \delta \bar{C}_{gsy} + \gamma T_{gsy} + \sum_{i=2}^{4} \gamma_i T_{gsy} * Q_i + \eta_{sy} + \varepsilon_{gsy} \quad (2)$$

Prior to reporting the regression results we describe teacher transitions to other campuses within the same district, other districts and out of the Texas public schools by principal quality and school poverty to provide a context with which to consider teacher transitions. Figure 1 shows that the teacher transition rate is highest in schools with the least effective principals regardless of the rate of school poverty, consistent with concerns that teacher turnover is quite harmful to school quality. However, in the remaining three categories there is little difference in overall turnover, with the exception of the highest poverty schools in which turnover in the 2nd quartile of principal quality is closer to the bottom quartile than the others. In fact turnover in the top principal quality schools is uniformly higher than that in the next category.

In terms of teacher destination, it is the rate of departure to other districts that tends to be much higher in schools with the least effective principals and lower in schools with the most effective principals; in fact district switching decreases monotonically as principal quality rises in all four poverty categories. Hanushek et al (2005) finds that districts switchers tend on average to outperform teachers moving within the district and those exiting the public schools entirely, and differences in the rate of district switching is consistent with the notion that higher quality principals are losing a smaller share of more effective teachers.

We turn now to the results of the analysis of teacher turnover and principal quality. Table 8 reports teacher exit rate coefficients from un-weighted (top panel) and enrollment weighted (bottom panel) regressions for all schools combined (Column 1) and by school share of students eligible for subsidized lunch (Columns 2-5). The top coefficient in each panel shows the relationship between the share of exiting teachers in

the grade and grade average achievement for the bottom quartile of principals, and the remaining rows show the differentials between the relationships for the other three quartiles and the bottom quartile. Negative interaction terms indicate more negative selection of exiting teachers in the other quartile than in the bottom quartile.

Both the top and bottom panels produce a similar pattern of estimates that show a monotonic pattern of increasingly negative selection for departing teachers as principal quality rises in the sample with all schools combined. In both cases the hypothesis that there is no difference by principal quality quartile in the relationship between grade average achievement and the exit rate is rejected at the 0.01 level. The fact that these estimates are based on grade averages and thus rough measures of the probability of having a very ineffective teacher may well account for the lack of significance.

Although all interaction coefficients in Table 8 are negative, by far the strongest ordering by principal quality appears in the high poverty schools. In these schools all coefficients are negative and the coefficient for the highest quality principals is highly significant. These schools experience higher teacher turnover than lower poverty schools, which may result from more difficult working conditions.

The possibility that unobserved factors affect the baseline principal quality estimates used in these regressions raises some questions about the attribution of the pattern of interaction effects to differences in principal quality. Therefore we present additional evidence based upon the expanded sample of all principals and the principal quality estimates generated by specifications that include school fixed effects.

Although noisier and less systematic than the estimates generated from the three year sample without school fixed effects, the expanded sample estimates in Table 9 show

a similar pattern overall and for the high poverty schools. In particular, the top panel based on a specification that uses principal quality estimates generated from a specification that includes school fixed effects shows teacher turnover-principal quality interaction coefficients for the highest category of principal quality that are negative and significant for both the entire sample (at the ten percent level) and for the highest poverty schools (at the five percent level). Moreover, for the sample as a whole the results show the expected pattern of larger interaction coefficients for higher principal quality quartiles.

Taken as a whole, these results support the interpretation of the principal fixed effects as measures of principal quality. Not does the negative selection of exiting teachers become stronger as principal quality rises, but the strongest relationship appears in the high poverty schools, precisely the schools with the largest variance in estimated principal quality and highest rate of teacher turnover.

VIa. Student Attendance

Improvements in student behavior constitute another channel through which effective principals can improve the quality of education by reducing time lost to disruption, raising expectations, and reducing absences. Unfortunately we have only limited data on discipline and no information on expectations, but we do have information on absences. We now examine whether more effective principals increase attendance in order to investigate the existence of a connection between our measure of principal effectiveness and student absenteeism. Table 10 presents results from the three year sample, and Table 11 presents estimates from the expanded sample based on

estimates of principal quality generated from specifications that include school fixed effects.

Table 10 reports the estimated effects of principal quality on the attendance rate from regressions of the school by year rate of attendance on average achievement in the year prior to the start of the principal's tenure and a full set of demographic characteristics; the regressions use the three year sample and are weighted by enrollment. The results in Column 1 for all schools show that attendance is higher in schools with higher quality principals, other things equal. The strength of this relationship varies by poverty level, being weakest in the highest poverty schools in contrast to the findings for teacher turnover.

Table 11 reports results from the same specification estimated over the expanded sample with principal quality estimates generated from specifications that alternatively include or exclude school fixed effects. Regardless of the specification used in the estimation of the principal fixed effects the results show that attendance is significantly lower in schools with principals in the lowest effectiveness quartile. However, there is no strong ordering among the other three quartiles, and in contrast to the other estimates the results are weaker in the highest poverty schools. It should be noted that a higher rate of school switching during the academic year in higher poverty schools may introduce substantial noise into these estimates.

VII. Conclusion

An important facet of many school policy discussions is the role of strong leadership, particularly of principals. Leadership is viewed as especially important in

revitalizing failing schools. This discussion is, however, largely uninformed by systematic analysis of principals and their impact on student outcomes.

Understanding the impact of principals on learning is a particularly difficult analytical problem. The non-random sorting of principals among schools and consequent difficulty separating the contributions of principals from the influences of peers and other school factors raise questions about the degree to which principals are responsible for differential outcomes.

Panel data on student performance that are linked to principals and schools permit facilitate the identification of principal effectiveness. We use a value-added model to estimate principal fixed effects under the assumptions that lagged achievement accounts for unobserved heterogeneity and that the estimates are not confounded by unobserved school factors not caused by the principal.

The results suggest the existence of substantial variation in principal effectiveness, particularly in higher poverty and lower achieving schools. Allowance for test issues including measurement error and test difficulty does not change these results. These results are consistent with both the hypothesis that principal skill is more important in the most challenging schools and the hypothesis of larger variation in underlying skills in high poverty schools, and these explanations need not be mutually exclusive.

Patterns of principal transitions suggest that it is the least and most effective that tend to leave schools, suggesting some combination of push and pull factors; this pattern is particularly pronounced in higher poverty schools. A troubling finding on transitions shows that a substantial share of ineffective principals in high poverty schools take principal positions in other schools and districts.

Of course the semi-parametric estimates of principal quality raise immediate questions about interpretation and the value of supporting evidence. The inclusion of school fixed effects reduces estimates of the variance of principal effectiveness by roughly 75 percent, in line with patterns observed in the estimation of the variance of teacher effectiveness. Although the school fixed effects account fully for time invariant differences among schools, it remains possible that changes in unobserved factors that accompany principal turnover could bias these estimates.

Therefore we examine changes in the stock of teacher quality and the school attendance rate in order to seek out additional evidence on the validity of the interpretation of the estimates as capturing real differences in principal quality. The finding that the negative selection of exiting teachers is stronger in schools with higher value added principals supports the view that the fixed effects capture differences in principal quality. These results also support the belief that the improvement in the stock of teacher quality provides an important channel through which principals can raise the quality of education. Finally, the findings on student attendance add further support for the semi-parametric approach to the measurement of principal quality.

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Table 1. The Distribution of Principals by Gender, Race, Ethnicity, and Experience, 1995-2002

	All Principals				First Year Principals		
	Female	Black	Hispanic	N	Female	Black	Hispanic
1995	52.6%	9.8%	18.0%	3,793	57.5%	11.3%	20.8%
1996	54.2%	10.0%	18.6%	3,864	62.4%	14.2%	21.6%
1997	55.7%	10.0%	18.7%	3,965	63.8%	9.6%	19.8%
1998	57.6%	10.3%	19.2%	4,026	63.5%	13.1%	23.3%
1999	59.1%	10.0%	19.6%	4,083	65.0%	8.6%	22.6%
2000	59.6%	10.2%	20.2%	4,158	61.7%	14.3%	20.9%
2001	60.8%	10.9%	20.4%	4,258	65.0%	12.9%	20.9%
2002	61.5%	11.2%	20.5%	4,331	65.2%	13.0%	23.1%

Table 2. Distribution of Principals by Tenure at Current School and Student Demographic Characteristics

		Principal Tenure						
	quartile	1	2	3	4	5	6 or more	
proportion eligible for subsidized lunch								
	bottom	17.8%	15.3%	12.6%	10.2%	8.2%	36.1%	100.0%
	2nd	19.8%	15.9%	12.3%	9.7%	7.9%	34.5%	100.0%
	3rd	20.5%	17.1%	13.7%	9.7%	7.9%	31.1%	100.0%
	top	19.5%	17.1%	13.2%	10.5%	8.2%	31.6%	100.0%
proportion black								
	bottom	20.7%	17.1%	13.5%	10.3%	7.9%	30.6%	100.0%
	2nd	18.5%	15.5%	12.8%	10.2%	7.9%	35.0%	100.0%
	3rd	18.3%	15.9%	12.6%	9.7%	8.6%	35.0%	100.0%
	top	20.1%	16.8%	12.8%	9.9%	7.8%	32.7%	100.0%
proportion Hispanic								
	bottom	19.1%	15.7%	12.2%	9.9%	7.9%	35.2%	100.0%
	2nd	19.2%	15.9%	12.8%	9.5%	7.9%	34.8%	100.0%
	3rd	19.3%	16.3%	12.9%	10.1%	8.4%	33.0%	100.0%
	top	19.9%	17.5%	13.8%	10.6%	8.0%	30.2%	100.0%
Initial Math Achievement								
	bottom	22.7%	19.4%	14.3%	9.8%	7.4%	26.3%	100.0%
	2nd	20.4%	16.7%	12.7%	10.0%	8.4%	31.9%	100.0%
	3rd	18.1%	15.3%	12.5%	10.1%	7.9%	36.3%	100.0%
	top	16.4%	14.0%	12.2%	10.2%	8.5%	38.8%	100.0%

Table 3. Principal Transitions by Tenure

transition	new role	Years of Tenure as Principal at School			
		1	2	3 to 5	6 or more
same campus	Principal	72.5%	68.0%	69.2%	70.8%
change campus, same district	Principal	3.9%	4.9%	6.0%	4.7%
change district	Principal	2.0%	2.5%	2.3%	1.0%
same campus	Other	0.8%	0.6%	0.3%	0.2%
change campus, same district	Other	2.0%	2.1%	2.2%	2.1%
change district	Other	1.7%	1.7%	1.1%	0.5%
same district central office	administration	0.7%	1.3%	1.6%	1.3%
new district central office	administration	0.5%	0.7%	0.7%	0.4%
exit Texas public schools		16.0%	18.1%	16.7%	19.0%
		100.0%	100.0%	100.0%	100.0%

Table 4. Mean, Variance, and Select Quantiles of the Distribution of Principal by Three Year Spell Fixed Effects, by the Share of Students in a School That Are Eligible for Subsidized Lunch

			Percentiles				
	Mean	Variance	10th	25th	50th	75th	90th
Share low income quantile							
Bottom	0.025	0.025	-0.180	-0.063	0.032	0.134	0.215
2nd	-0.030	0.031	-0.243	-0.142	-0.032	0.086	0.190
3rd	-0.043	0.043	-0.301	-0.162	-0.036	0.103	0.207
Top	-0.062	0.069	-0.383	-0.236	-0.068	0.114	0.285
All	-0.028	0.043	-0.286	-0.153	-0.019	0.109	0.222

Table 5. Alternative Estimates of the Mean, Variance, and Select Quantiles of the Distribution of Principal by Spell fixed effects, by the Share of Students in a School That Are Eligible for Subsidized Lunch and Steps Taken to Mitigate Problems Related to Test Measurement

			Percentiles				
	Mean	Variance	10th	25th	50th	75th	90th
Estimates Shrunk							
Share low income quantile							
Bottom	0.024	0.025	-0.179	-0.063	0.030	0.133	0.213
2nd	-0.031	0.030	-0.241	-0.141	-0.033	0.084	0.186
3rd	-0.044	0.040	-0.296	-0.161	-0.037	0.094	0.200
Top	-0.061	0.061	-0.364	-0.228	-0.068	0.102	0.266
All	-0.028	0.040	-0.280	-0.150	-0.020	0.106	0.214
Re-weighted Data							
Share low income quantile							
Bottom	0.071	0.048	-0.130	-0.057	0.035	0.146	0.355
2nd	0.063	0.052	-0.167	-0.070	0.025	0.154	0.350
3rd	0.065	0.066	-0.192	-0.085	0.029	0.176	0.394
Top	0.085	0.125	-0.266	-0.125	0.038	0.241	0.571
All	0.071	0.073	-0.182	-0.082	0.031	0.174	0.417
Shrunk Estimates Based on Re-weighted Data							
Share low income quantile							
Bottom	0.070	0.042	-0.119	-0.050	0.035	0.143	0.336
2nd	0.063	0.045	-0.152	-0.064	0.026	0.147	0.334
3rd	0.064	0.055	-0.170	-0.077	0.030	0.163	0.368
Top	0.080	0.091	-0.218	-0.102	0.040	0.216	0.498
All	0.069	0.058	-0.162	-0.071	0.032	0.164	0.385

Table 6. Mean, Variance, and Select Quantiles of the Distribution of Principal by Spell Fixed Effects, by the Share of Students in a School That Are Eligible for Subsidized Lunch and Inclusion of School Fixed Effects

No School Fixed Effects			Percentiles				
	Mean	Variance	10th	25th	50th	75th	90th
Share low income quantile							
Bottom	0.132	0.032	-0.089	0.018	0.147	0.256	0.337
2nd	0.085	0.037	-0.146	-0.048	0.082	0.218	0.322
3rd	0.112	0.053	-0.187	-0.032	0.114	0.277	0.399
Top	0.133	0.077	-0.218	-0.059	0.144	0.312	0.478
All	0.115	0.050	-0.160	-0.030	0.120	0.263	0.378

No School Fixed Effects			Percentiles				
	Mean	Variance	10th	25th	50th	75th	90th
Share low income quantile							
Bottom	-0.000	0.006	-0.088	-0.040	0.000	0.039	0.088
2nd	0.001	0.009	-0.110	-0.048	0.000	0.045	0.119
3rd	-0.004	0.014	-0.138	-0.063	0.000	0.054	0.133
Top	0.004	0.019	-0.161	-0.064	0.000	0.071	0.171
All	-0.000	0.012	-0.124	-0.052	0.000	0.051	0.125

Table 7. Principal Transition Distribution for Principals with less than 25 years of experience in the Texas Public Schools, by Quartile of Principal Fixed Effect and the Share of Students in a School That Are Eligible for Subsidized Lunch

Share low income quartile bottom				
	Quartile of principal fixed effect			
Fourth Year Transition	Q1	Q2	Q3	Q4
Same campus, principal	58.62%	68.03%	73.48%	76.34%
Same campus, other	1.15%	0.00%	0.76%	0.00%
Moves campus, principal	4.60%	4.10%	4.55%	4.30%
Moves campus, other	0.00%	0.82%	1.52%	2.15%
Same district, distr. Admin	0.00%	4.10%	1.52%	2.15%
Moves district, principal	2.30%	1.64%	3.79%	4.30%
Move district, other	3.45%	0.00%	1.52%	0.00%
Move district, district admin	2.30%	0.00%	0.76%	2.15%
Exits	27.59%	21.31%	12.12%	8.60%
	100.00%	100.00%	100.00%	100.00%
Second				
Fourth Year Transition	Q1	Q2	Q3	Q4
Same campus, principal	52.43%	70.15%	81.45%	71.70%
Same campus, other	0.97%	0.00%	0.00%	0.00%
Moves campus, principal	3.88%	2.24%	0.81%	6.60%
Moves campus, other	2.91%	0.75%	0.81%	0.94%
Same district, distr. Admin	1.94%	0.75%	1.61%	0.00%
Moves district, principal	0.97%	5.97%	2.42%	5.66%
Move district, other	1.94%	3.73%	2.42%	0.00%
Move district, district admin	0.97%	1.49%	0.81%	0.00%
Exits	33.98%	14.93%	9.68%	15.09%
	100.00%	100.00%	100.00%	100.00%
Third				
Fourth Year Transition	Q1	Q2	Q3	Q4
Same campus, principal	44.36%	55.28%	63.81%	58.06%
Same campus, other	0.75%	0.00%	0.00%	0.00%
Moves campus, principal	7.52%	5.69%	9.52%	8.06%
Moves campus, other	0.75%	2.44%	2.86%	1.61%
Same district, distr. admin	3.76%	2.44%	0.95%	0.81%
Moves district, principal	4.51%	4.88%	1.90%	7.26%
Move district, other	2.26%	1.63%	1.90%	0.81%
Move district, district admin	0.75%	2.44%	0.00%	0.00%
Exits	35.34%	25.20%	19.05%	23.39%
	100.00%	100.00%	100.00%	100.00%

Top				
	Quartile of principal fixed effect			
Fourth Year Transition	Q1	Q2	Q3	Q4
Same campus, principal	62.59%	73.17%	72.28%	67.39%
Same campus, other	0.00%	0.00%	0.00%	0.00%
Moves campus, principal	8.63%	10.98%	6.93%	7.25%
Moves campus, other	0.72%	1.22%	0.99%	1.45%
Same district, distr. admin	0.00%	0.00%	0.99%	0.00%
Moves district, principal	3.60%	1.22%	2.97%	1.45%
Move district, other	0.72%	1.22%	0.00%	0.72%
Move district, district admin	2.16%	0.00%	0.00%	0.72%
exits	21.58%	12.20%	15.84%	21.01%
	100.00%	100.00%	100.00%	100.00%

Table 8. Coefficients on Principal Quality Quartile-Teacher Turnover Interactions from Unweighted and Weighted Regressions of Achievement on These Interactions, Lagged Achievement, Demographic Characteristics, Campus by Year Fixed Effects and Grade by Year Fixed Effects, by the Share of Students in a School That Are Eligible for Subsidized Lunch (absolute value of t-statistics in parentheses; data aggregated to campus by grade by year level)

		Quartiles of Poverty Share			
	All	Lowest	Second	Third	Highest
Unweighted					
share teachers exiting	0.017	0.023	0.041	0.017	0
	(0.80)	(0.37)	(1.00)	(0.45)	(0.01)
share exiting*2nd q	-0.05	-0.005	-0.039	-0.073	-0.092
principal quality	(1.80)	(0.07)	(0.78)	(1.44)	(1.60)
share exiting*3rd q	-0.071	-0.07	-0.08	-0.05	-0.11
principal quality	(2.50)	(1.00)	(1.47)	(0.94)	(1.82)
share exiting*4th q	-0.099	-0.049	-0.053	-0.079	-0.193
principal quality	(3.49)	(0.70)	(0.99)	(1.50)	(3.52)
Join F Test-interactions	4.299	0.829	0.757	0.937	4.172
p-value	0.005	0.478	0.518	0.422	0.006
Weighted by campus by year enrollment					
share teachers exiting	0.008	-0.009	0.063	0.001	-0.016
	(0.43)	(0.23)	(2.35)	(0.04)	(0.47)
share exiting*2nd q	-0.014	0.023	-0.032	-0.044	-0.044
principal quality	(0.59)	(0.45)	(0.82)	(0.92)	(0.80)
share exiting*3rd q	-0.06	-0.037	-0.104	-0.046	-0.086
principal quality	(2.36)	(0.82)	(2.37)	(0.78)	(1.10)
share exiting*4th q	-0.072	-0.023	-0.057	-0.041	-0.194
principal quality	(2.76)	(0.49)	(1.20)	(0.75)	(3.25)
Join F Test-interactions	3.634	0.863	1.972	0.361	3.603
p-value	0.012	0.46	0.117	0.781	0.013

Table 9. Coefficients on Principal Quality Quartile-Teacher Turnover Interactions from Regressions of Achievement on These Interactions, Lagged Achievement, Demographic Characteristics, Campus by Year Fixed Effects and Grade by Year Fixed Effects Using the Expanded Sample, by the Presence of School Fixed Effects in the Principal Quality Regression and Share of Students in a School Eligible for a Subsidized Lunch (absolute value of t-statistics in parentheses; data aggregated to campus by grade by year level)

		Quartiles of Poverty Share			
	All	Lowest	Second	Third	Highest
School Fixed Effects					
share teachers exiting	-0.009	-0.039	0.004	0.024	-0.029
	-0.68	-1.49	0.19	1	0.9
share exiting*2nd q principal quality	-0.006	0.011	0.001	-0.043	0.005
	0.36	0.36	0.02	1.25	0.12
share exiting*3rd q principal quality	-0.015	0.047	-0.035	-0.055	-0.043
	0.8	1.43	1.06	1.38	0.88
share exiting*4th q principal quality	-0.033	0.033	-0.026	-0.036	-0.094
	1.73	0.93	0.76	1.05	2.09
Join F Test-interactions	1.184	0.954	0.656	0.827	2.7
p-value	0.314	0.414	0.579	0.479	0.079
No School Fixed Effects					
share teachers exiting	-0.014	-0.035	0.015	-0.004	-0.035
	1.18	1.51	0.79	0.17	1.38
share exiting*2nd q principal quality	0.007	0.044	-0.041	0.013	0.01
	0.47	1.46	1.6	0.38	0.21
share exiting*3rd q principal quality	-0.023	0.004	-0.025	-0.069	0
	1.33	0.12	0.75	1.85	0
share exiting*4th q principal quality	-0.031	0.01	-0.036	0.035	-0.108
	1.58	0.31	0.86	0.93	2.64
Join F Test-interactions	1.992	1.076	0.902	2.687	2.993
p-value	0.113	0.358	0.439	0.045	0.03

Table 10. Estimated Effects of Principal Quality on Student Attendance Rate Controlling for Lagged Achievement, Demographic Characteristics, and Grade Shares, by the Share of Students in a School That Are Eligible for Subsidized Lunch (absolute value of t-statistics in parentheses; data aggregated to campus by year level; estimates weighted by enrollment)

		Quartiles of Poverty Share			
	All	Lowest	Second	Third	Highest
Principal quality 2nd Quartile	0.0019 (4.42)	0.0008 (1.00)	0.0026 (3.52)	0.0044 (5.33)	-0.0007 (0.81)
Principal quality 3rd Quartile	0.0024 (5.36)	0.0024 (3.12)	0.0036 (4.78)	0.004 (4.33)	-0.0013 (1.43)
Principal quality top Quartile	0.0029 (5.76)	0.0016 (2.04)	0.0049 (6.07)	0.0031 (3.14)	0.0009 (0.91)
Join F Test-interactions p-value	11.957 0.000	5.936 0.001	12.973 0.000	10.102 0.000	2.254 0.081

Table 11. Estimated Effects of Principal Quality on Student Attendance Rate Controlling for Lagged Achievement, Demographic Characteristics, and Grade Shares Using the Expanded Sample, by the Presence of School Fixed Effects in the Principal Quality Regression and the Share of Students in a School That Are Eligible for Subsidized Lunch (absolute value of t-statistics in parentheses; data aggregated to campus by year level; estimates weighted by enrollment)

		Quartiles of Poverty Share			
	All	Lowest	Second	Third	Highest
School Fixed Effects					
Principal quality 2nd	0.0008	0.0003	0.0004	0.0013	0.0009
Quartile	2.66	0.78	0.81	2.12	1.46
Principal quality 3rd	0.0004	0.0007	0.0002	0.0001	0.0005
Quartile	1.25	1.78	0.44	0.19	0.72
Principal quality top	0.0009	0.0013	0	0.0014	0.0009
Quartile	3.00	3.06	0.02	2.02	1.63
Join F Test-interactions	3.7	3.73	0.34	2.37	1.1071
p-value	0.0113	0.011	0.7998	0.0685	0.3451
No School Fixed Effects					
Principal quality 2nd	0.0024	0.0018	0.0015	0.0043	0.0018
Quartile	7.31	3.91	3.10	5.66	2.69
Principal quality 3rd	0.0027	0.0026	0.0021	0.0040	0.0016
Quartile	7.62	5.02	3.63	4.99	2.32
Principal quality top	0.0033	0.0028	0.0029	0.0041	0.0025
Quartile	8.88	4.94	5.09	5.44	3.64
Join F Test-interactions	27.93	9.05	8.72	12.56	4.6169
p-value	0	0	0	0	0.0032

Figure 1. Teacher Transitions by Principal Effectiveness and Share of Students in a School Eligible for a Subsidized Lunch