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Principal Turnover and Effectiveness

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ABSTRACT

While much has been written about the importance of school leadership, there is surprisingly little systematic evidence about this topic. This paper presents preliminary estimates of key elements of the market for school principals, employing rich panel data on principals for the State of Texas. The consideration of teacher movements across schools suggests that principals follow quite similar patterns to those of teachers – preferring schools that have less demands as indicated by higher income students, higher achieving students, and fewer minority students. When we turn to the impact of principals on student achievement, we find some small but significant effects of the tenure of a principal in a school. More significant, however, are the estimates of variations in principal effectiveness. The most effective principals tend to be those in schools with higher income and higher achieving students. But these tendencies are small compared to the estimates of the overall variation in principal effectiveness.

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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] The recent expansion of school accountability and performance incentives brings renewed emphasis on the importance of principals in the determination of school quality. Federal accountability statutes in No Child Left Behind insist that all states take testing, accountability, and sanctions to the individual school level, thus elevating the importance of leadership in the individual building. Publicly available reporting on student achievement, particularly in comparison with schools serving similar populations, places additional pressure on principals to raise achievement. Yet, given the central role of principals, there is remarkably little systematic evidence either about the labor market for principals or about principals' effects on student performance.

From case studies and anecdotal accounts, the importance of principals is most apparent when considering schools serving disadvantaged populations. The demands of schools with poor-performing students appear to inflate the importance of hiring and retaining effective leaders. Part of the general problem of schools serving disadvantaged student populations is that they present more difficult and strenuous work conditions for everybody.[3] Thus, schools for more difficult to serve populations have added challenges in the principal labor market that could reinforce and amplify other disadvantages such as the ease of attracting and retaining effective teachers or the ability to deal with a difficult student peer environment – severely handicapping any efforts to raise school quality in the most needy schools.

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[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).

[3] Hanushek and Rivkin (2007)

The limited evidence to date suggests that turnover is higher in high poverty schools, implying that students in these schools are much more likely to have a principal with little or no experience (Gates et al. (2006)). This pattern mirrors the findings for teachers and suggests that an inexperienced administrator provides an additional obstacle to academic success for many high poverty communities.[4] Whether experienced principals tend to move to higher achieving, higher income schools as appears to be the case with teachers as well as other aspects of the dynamics of the principal labor market remains to be seen. Moreover, the ultimate impacts of mobility depend upon the quality of principals who settle in different schools, and experience is only one of many determinants of quality.

This paper is a preliminary excursion into the dynamics of the principal labor market. We provide a description of principal transitions across schools and estimate some characteristics of the distribution of principal effectiveness and its link with student demographic characteristics. The availability of administrative data on teachers and students for the state of Texas enables us to describe principal transitions including entry into the position from teaching or another administrative post in the Texas public schools and examine transition differences by student demographic characteristics. Moreover, the mathematics and reading test scores administered each spring to grades three through eight permit us to include achievement as an additional student characteristic, and more importantly, to estimate the distribution of principal effects on achievement and the return on principal experience and tenure.

The identification of principal quality as measured by value-added to achievement requires the separation of the contribution of principals from other school factors and is complicated by the fact that principals affect students indirectly through decisions regarding teacher hiring and retention and directly through the establishment of specific policies or the development of a school culture conducive to learning. Therefore the quality of the current stock

[4] Hanushek, Kain, and Rivkin (2004) and Boyd, Lankford, Loeb, and Wyckoff (2005) provide information on teacher turnover.

of teachers and staff likely depends in part on choices made by the current principal and in part on decisions made by predecessors or administrators at the district level.

Any systematic sorting of principals among schools of course complicates further the estimation of principal effectiveness and raises the specter of producing estimates that conflate differences in true principal effectiveness with differences in student or school characteristics. Studies to date including Brewer (1993) and Eberts and Stone (1988) use panel data to control for student differences by adopting value-added specifications that account directly for observed characteristics. These studies find evidence that principal quality positively affects achievement, but the possibility that unobserved student or school level characteristics introduce bias remains.

We make use of multiple years of administrative data that follows students and school personnel over time to control for student heterogeneity and unobserved school differences. Specifically, the inclusion of school fixed effects accounts for persistent differences among schools related to both principal transitions and student outcomes, and the inclusion of prior achievement as an explanatory variable accounts for differences in student background and prior school experiences. Importantly, estimates of principal effectiveness can in general be produced for only those who switch schools, as the effectiveness of a non-mover cannot be identified separately from the impact of other persistent aspects of a school. In addition to estimating principal effectiveness for each school switcher we also estimate average effects of overall principal experience and tenure at a single school on achievement.

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 both 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 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 years of experience in the Texas public schools 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 experience, tenure, demographic characteristics and student demographic characteristics using data for school years 1995 to 2001. It begins by looking at the overall distribution by experience and tenure, next turns to changes

[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.

over time, and finally examines experience and tenure differences by student demographic characteristics.

The first fact is that there is considerable turnover in principals as seen from the individual school. Twenty percent of principals, as shown in Table 1, are in their first year at their current school, and almost half have been at their current school for three or fewer years. But, interestingly, at the other end of the distribution, over one-third has been at their current school six or more years.

A substantial portion of the principals with limited tenure in schools simply reflects the numbers of new principals in the state. Over 10 percent have no prior experience as principals in the Texas public schools, and over 30 percent have fewer than three years of prior experience as a principal. Looking across the experience categories of the principal, however, one sees that about 10 percent of principals go to a new school each year. More than 20 percent of those in their first year at their current school have greater than five years of experience. Thus, the distribution of tenure in schools reflects not only the overall distribution of experience of principals but also the patterns of movement among schools.

Tables 2 describes differences in experience by student income, race-ethnicity, and quartile of the mathematics test score distribution. As expected from the operation of teacher labor markets,[6] low income and non-white students are more likely to have principals with little or no prior experience. Table 2 shows that low income students are roughly 10 percent (0.9 percentage points) more likely to have a first year principal, and slightly less than 10 percent less likely to have a principal with at least five years of prior experience; a quite similar pattern holds for blacks and Hispanics versus whites. Somewhat more pronounced is the principal experience differential across quartiles of the mathematics test score distribution. Students in the bottom quartile are more than 20 percent (2.1 percentage points) more likely to have a new principal than students in the top quartile and slightly more than 10 percent (5.3 percentage points) less likely to

[6] Hanushek, Kain, and Rivkin (2004)

have a principal with at least five years of prior experience. Roughly one in eight students in the bottom quartile have a new principal and only half have a principal with at least 5 years of prior experience.

Figure 1 provides the simple comparison of the student demographics for principals with six or more years experience compared with those having less that six years experience. From this, there is the unmistakable pattern of more experienced principals gravitating toward less challenging schools – those with higher income students, with more white students, and with higher achieving students.

Table 3 shows that tenure differences follow much the same pattern as overall experience differences of principals. Roughly twenty percent of students in the bottom mathematics score quartile have a principal in her first year at the school, and less than one third have a principal who has been at the school for at least five years. In contrast, only 16.6 percent of students in the top mathematics score quartile (roughly 20 percent fewer) have principals who are new to the school, and over 35 percent have principals who have been at the school at least five years. The one clear difference between experience and tenure is that black students are much more likely than Hispanics to have a principal who has been at the school at least five years; the black-white difference is smaller than the corresponding experience differential.

Figure 2 shows the aggregate breakdown of principals with four or more years tenure in the school versus those with shorter tenures. Again, a principal in an easier to manage school tends to stay there longer.

Texas has experienced growth in the student (and principal) population over this time period, and it has led to some noticeable changes in the composition of principals. Table 4 describes trends over time in the share of all principals and first year principals who are female, black, and Hispanic respectively. While each of these groups increases 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 only half

of the new principals were women in 1995, over 70 percent of the entering principals were women in 2002.

The increases in the black and Hispanic shares were smaller in absolute terms but larger relative to the much lower bases. Between 1995 and 2002 the black principal share increased by over 15 percent, rising from 9.8 to 11.4 percent of all principals. The share of principals who are Hispanic also increased by roughly 15 percent, rising from 17.6 percent to 19.7 percent between 1995 and 2002. As was the case for women, the increases in the black and Hispanic shares of all principals resulted from the substantial increases in newly recruited principals over this period. The increase in the share of first year principals who are black was particularly pronounced in the later years.

The overall picture of principals mirrors that of teachers – not overly surprising since the vast majority of principals were teachers immediately before moving into administration. The principals also tend to show the same kinds of preferences as teachers do. They tend to move toward "easier" schools, those with a higher achieving, higher income, and more white population.

At the same time, there have been some dramatic changes in the recruiting of new principals with an emphasis on females, blacks, and Hispanics. This altered recruiting shows up in noticeable movement of the overall composition of principals.

IV. Estimation of Differences in Principal Effectiveness

As noted, the historic anecdotal discussions of schools conclude that good schools need, first and foremost, good leaders.[7] Yet the empirical literature is practically devoid of any attempts to estimate the variation in effectiveness of principals that exists.[8]

This section examines the variation in principal effectiveness as measured by value-added to mathematics achievement and the contributions of both total experience as a principal in

[7] See, for example, Edmonds (1979)
[8] One of the few attempts is Eberts and Stone (1988).

the Texas public schools and tenure at the current school to value added. This effort requires the separation of principal effects from potentially confounding student and school factors. We begin by developing the empirical model and then turn to the results.

A. Empirical Model

Existing papers generally regress achievement on lagged achievement, sets of individual, family, and school characteristics, and a list or observed principal characteristics or school variables that are assumed to reflect principal effectiveness. These models rely on the following two assumptions to achieve identification: 1) the included principal variables are orthogonal to unmeasured school factors and any random error component; and 2) the included principal variables are orthogonal to any additional systematic principal factors. The first assumption rules out bias from confounding student, family, and school factors, while the second assumption rules out bias from related principal characteristics. Unfortunately, experience has taught us that these identifying assumptions are frequently not meet. Despite the use of a value added framework and inclusion of available controls, the sorting of principals among schools and correlation among principal characteristics in particular raises questions about the validity of these assumptions.

Our approach is to embed the analysis of principal effects within a more general achievement model, where panel data techniques relying on multiple observations of individuals and schools are employed to purge the models of systematic but poorly identified influences on student learning. Our basic models relate achievement (A) for student i in school s with principal p in grade g in year y as a function of prior achievement, observed student characteristics (X), time and potentially grade varying school and peer characteristics (C), and measures of principal effects. We parameterize the principal impact through a combination of a principal fixed effect (θ) and time-varying elements of the overall experience as the principal (exp) and the principal's tenure at the current school (ten). Because of concerns about unmeasured school factors, including student and teacher selection into individual schools, we generally include a school fixed effect (ω). Thus, adding a random error (ε), the empirical model is:

$$(1) \qquad A_{ispgy} = \lambda A_{i,g-1,y-1} + \beta X_{igsy} + \delta C_{sgy} + \gamma \exp_{py} + \alpha ten_{py} + \theta_p + \omega_s + \varepsilon_{ispgy}$$

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.[9]

The administrative data enable us to account for unobserved school and principal differences through the inclusion of school and principal fixed effects. The school fixed effects absorb time invariant differences in school factors including facilities and peer group composition, while the principal fixed effects absorb time invariant differences in principal quality. Importantly, the fixed effect for a school run by principals who work only for that school is perfectly collinear with the sum of the fixed effects of those principals. Moreover, this model does not permit estimation of the effects of principal characteristics such as college quality that do not vary over the career.

Following the estimation of the full fixed effects models we will retrieve the principal fixed effects and examine the variation in principal quality for those principals who switch schools. As many have pointed out in terms of both accountability and teacher value-added estimation, these effects are noisy measures of true principal value added and thus the observed

[9] 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.

variance overstates the true variance of principal value added.[10] In this preliminary analysis such corrections have not been undertaken, but in the future we will use shrinkage estimation methods to generate measurement error adjusted estimates of the principal value added variance. Note, however, that such error does not bias comparisons of average quality differences by student income, race, or ethnicity.

B. Results

The empirical analysis focuses on two aspects of the variation in principal quality, differences due to experience and tenure and fixed differences in principal effectiveness. Although we have a strong prior that there is a positive relationship between principal effectiveness and experience, the same cannot be said for the relationship between principal effectiveness and tenure. 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 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. One would there expect the effect of a principal on the quality of instruction in a school to grow over time, but whether or not the effect is positive depends crucially upon whether the personnel decisions of the current principal are superior to those of the prior principal. In future work we intend to address this issue in greater depth by combining information on principal and teacher effectiveness, but at this point we estimate only the average tenure effect.

The discussion of the results begins with an examination of the estimated effects of experience and tenure in the absence of either principal or school fixed effects, examine the sensitivity of the experience and tenure effects to the inclusion of such controls, and then describe

[10] In terms of overall school accountability, see Kane and Staiger (2002). For estimation of teacher effects, a wide range of people have commented on issues of measurement errors. See, for example, Sanders and Horn (1994), Rockoff (2004), or Gordon, Kane, and Staiger (2006).

the distribution of principal fixed effects and examine whether there are substantial differences by student demographic characteristics.

Table 5 displays the individual and joint effects of principal experience and tenure on mathematics achievement, where each of the semi-parametric estimates is compared to principals with 6 or more years of experience or of tenure. The table provides estimates of these effects with and without school fixed effects and principal fixed effects. The table clearly reveals that the estimated effects of principal experience on achievement are sensitive to the inclusion of the tenure variables and both school and principal fixed effects.

In the absence of these other controls, the coefficients in Column 1 show that principals appear to improve with experience, as all the experience coefficients are significant at the 10 percent level and all but one at the five percent level. The magnitudes of these deficits (compared to a principal with six years experience are 0.025, 0.017, 0.013, and 0.009 for new, second year, third year, and fifth year principals, respectively. Note, however, that there is potential ambiguity in the interpretation of these estimates. The estimated effect of having two years experience, for example, combines positive selection (because principals who only serve one year are not observed) with any learning on the job. It is possible to distinguish between these two effects by considering the estimates in column 5 that include a principal fixed effect. Holding constant overall "fixed" quality, we see that the experience parameters follow the same pattern as in column 1, and thus they suggest that learning by doing is the primary contributor to the experience profile.

Of course, as hinted at, these experience effects may also be driven by other factors including tenure at a school or confounding school factors resulting from the non-random distribution of principal experience among schools. In fact the addition of school fixed effects to the basic model substantially reduces the magnitude of the experience coefficients reported in Columns 3, leaving only the coefficients on first and second year experience indicators significant at the 5 percent level. More importantly, the addition of the tenure variables, either alone or with campus or principal fixed effects, reduces the magnitude and significance of the experience coefficients to the point that none are significant at the five percent level.

In contrast, the coefficients on the first and second year tenure indicators are significant in all specifications. Interestingly, the inclusion of principal fixed effects actually increases both the magnitude and significance of these estimates, while the inclusion of school fixed effects has the opposite effect. Not surprisingly, the simultaneous inclusion of both school and principal fixed effects leaves the estimates in between what they were in specifications with only one of the two, though the estimates are closer to those produced by the principal fixed effect specifications. This pattern is consistent with the notion that underperforming schools are more likely to have principals new to the school, so in the absence of school fixed effects the tenure variables conflate the average effect of tenure with related and unobserved differences in school factors that affect achievement.

The estimated parameters come from achievement models where achievement has mean zero and standard deviation one and where lagged achievement is included. Thus, the interpretation is how much being in the first year of tenure as a principal affects student achievement growth in that year. A coefficient of -0.02 implies that the average student learns two-hundredths of a standard deviation less in the first year of a new principal. While this is small, an unstable school that keeps bringing in new principals can aggregate to a serious deficit in learning of the students.

The finding of small tenure and experience effects also does not rule out an important role for principals, as variations in fixed differences in principal effectiveness might be much larger, similar to the case for teachers. To investigate the magnitude of differences in overall principal quality, we have captured the fixed effect estimates for principals who work in at least two schools during the sample period. From these, we can compute mean differences by race, ethnicity, income, and mathematics test score quartile by weighting each principal fixed effect by the share of the respective category. We can also estimate the variance in overall principal effectiveness.

Table 6 reports mean principal fixed effects by the aforementioned characteristics for two sets of principal fixed effects. The first comes from a specification that does not control for school fixed effects, while the second one comes from a specification that does account for school fixed effects. In the absence of such school controls, the principal effects may conflate principal quality with the effect of school characteristics related to achievement, although estimating the impacts of principals as distinct from the schools is obviously more difficult.

The estimated differences in mean principal effectiveness are systematically related to student characteristics, and high-needs schools tend to get less effective leaders. From the models with school fixed effects, we see that low income students tend to be placed with less effective principals, although there are no differences in effectiveness by student race and ethnicity. The largest differences come, however, across the achievement distribution. This pattern is quite dramatic, as shown in Figure 3.[11] The differences in annual growth, reaching 0.07 standard deviations in comparisons of top quartile to bottom quartile, imply very substantial potential impacts.

The estimated principal effects also permit estimation of the variation in principal effectiveness. Uncorrected for measurement error, the models with school fixed effects indicate a

[11] This finding, nonetheless, requires further investigation, since the measures of teacher effectiveness are themselves derived from differentials in student achievement growth. At the same time these are within-principal estimates, which lessen this problem.

standard deviation of effectiveness of 0.27 (again measured in student growth terms for the entire school). We do not have direct estimates of the measurement error involved in these, but previous work on teacher value-added suggests that somewhat over half of the variance in estimated teacher effectiveness comes from measurement error.[12] Using these teacher estimates as a rough guide, the standard deviation of principal effectiveness would be 0.17. This is a truly large impact!

If these estimates are roughly the right order of magnitude, the impact of principals would be as large or larger than depicted in the anecdotal and case study literature. A good principal can dramatically change the learning in a school, and the results could cumulate to very noticeable impacts on ultimate learning.

V. Conclusions

This preliminary investigation of principal effectiveness suggests that more attention should be given to management and leadership issues in schools. First, in terms of overall patterns, it appears that principals have preferences that mirror those of teachers. Specifically, with experience principals tend to gravitate toward schools that are easier to run – schools serving higher income populations, more white students, and higher achieving students.[13] This implies also that schools serving more disadvantaged populations tend to have first-year principals (a generally negative factor for achievement). These tendencies reinforce the difficulties in teacher labor markets and imply a substantial challenge for school reform.

[12] The estimates in Hanushek and Rivkin (2008) present a range of the proportion of variance from measurement error of 0.5-0.7. Here we simply use 0.6 for the rough calculations. There is reason to believe, however, that the error variance for principal effects would be smaller, since these estimates rely upon larger samples of students and aggregate across different years – both of which would reduce the error variance.

[13] Some of this pattern might change, however, as an increasing portion of principals are black or Hispanics. In terms of teachers, black teachers tend to move to schools with higher percentages of black students (just the opposite of white teachers). On the other hand, female teachers are more sensitive to school demographic composition than males, and the movement toward more female principals may offset the racial patters. On teachers, see Hanushek, Kain, and Rivkin (2004).

Second, the differences in terms of effectiveness of the principal appear biased against the more needy students. Low income students and low achieving students on average get less effective principals.

Nonetheless, the large variation in principal effectiveness is perhaps the most important finding. Variations in principal effectiveness are very large and justify renewed attention to leadership.

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Table 1. Distribution of Principal Experience, Conditional on Tenure at Current School

Tenure at Current School	Experience as Principal						
	1st year	2nd year	3rd year	4th year	5th year	6th+ year	All
1st year	12.2%	.9%	1.1%	.9%	.8%	4.1%	20.0%
2nd year		9.8%	.7%	.8%	.8%	4.1%	16.3%
3rd year			7.8%	.6%	.6%	3.8%	12.8%
4th year				6.1%	.4%	3.4%	9.9%
5th year					4.9%	3.0%	7.9%
6th+ year						33.0%	33.0%
All	12.1%	10.7%	9.6%	8.4%	7.5%	51.6%	100.0%

Table 2. Distribution of Experience of Principals by Student Demographic Characteristics

	Years of Experience of Principal					
	1	2	3	4	5	6+
1. Income						
low income	11.8	11.0	9.8	8.7	7.9	51.1
not low income	10.9	10.0	9.2	8.1	7.4	54.8
2. Race-ethnicity						
Black	11.9	11.0	9.6	8.3	7.7	51.8
Hispanic	11.7	10.9	9.9	8.8	7.9	51.0
White	10.8	10.1	9.1	8.1	7.4	54.8
3. Math score quartile						
Bottom	12.5	11.4	10	8.6	7.9	49.9
2nd	11.5	10.7	9.6	8.5	7.7	52.2
3rd	10.9	10.2	9.3	8.4	7.6	53.8
Top	10.4	9.8	9.2	8.2	7.4	55.2
All Students	11.4	10.5	9.5	8.4	7.7	52.8

Table 3. Distribution of Tenure of Principals in Current School by Student Demographic Characteristics

	Years of tenure at current school by principal					
	1	2	3	4	5	6+
1. Income						
low income	19.3	16.8	13.3	10.4	8.3	32.1
not low income	18.2	15.9	13.0	10.4	8.4	34.6
2. Race-ethnicity						
Black	19.4	16.6	12.7	9.8	8.2	33.6
Hispanic	19.3	17.1	13.7	10.7	8.4	31.0
White	18.1	15.7	12.8	10.3	8.2	35.4
3. Math score quartile						
Bottom	20.6	17.7	13.6	10.2	8.1	30.1
2nd	18.9	16.5	13.2	10.4	8.4	33.0
3rd	18.0	15.9	13.0	10.5	8.4	34.5
Top	17.5	15.5	13.0	10.6	8.5	35.5
All Students	18.8	16.4	13.2	10.4	8.3	33.3

Table 4. Demographic Composition of Principals, 1995-2002

	Principals Who Are: (percent)			First Year Principals Who Are: (percent)		
	women	black	Hispanic	women	black	Hispanic
1995	52.9	9.8	17.6	50.7	9.5	18.8
1996	54.4	10.2	18.1	56.2	13.9	19.1
1997	55.8	10.1	18.3	65.5	9.5	20.7
1998	57.7	10.2	18.7	66.3	13.4	23.0
1999	59.1	10.1	19.1	63.0	9.0	21.2
2000	59.8	10.3	19.4	63.8	15.0	20.2
2001	61.0	11.0	19.4	71.6	16.0	22.0
2002	61.8	11.4	19.7	71.5	14.3	25.1

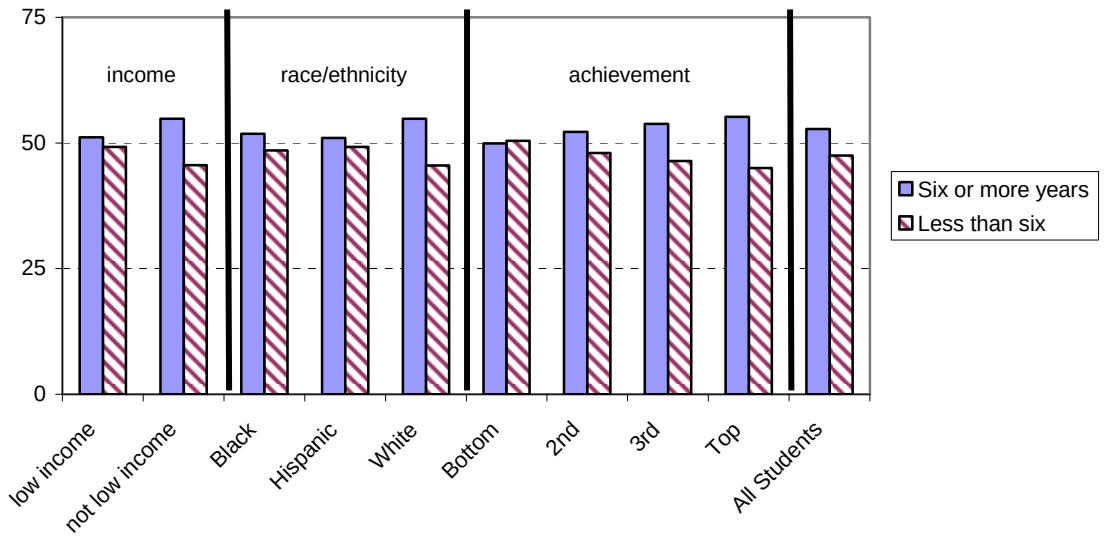
Table 5. Estimated Effects of Principal Experience and Tenure on Mathematics Achievement
(robust standard errors in parentheses)

principal fixed effects	Without principal fixed effects				With principal fixed effects			
	Without school fixed effects		With school fixed effects		Without school fixed effects		With school fixed effects	
experience dummies								
first year	-0.025	-0.003	-0.017	-0.009	-0.02	0.004	-0.024	-0.007
	(7.76)	(0.53)	(5.42)	(1.71)	(3.39)	(0.51)	(3.09)	(0.72)
second year	-0.017	-0.002	-0.008	0.003	-0.014	0.008	-0.017	0.001
	(4.82)	(0.39)	(2.47)	(0.57)	(2.29)	(1.05)	(2.56)	(0.15)
third year	-0.013	-0.008	-0.002	0.0001	-0.009	-0.004	-0.01	-0.004
	(3.66)	(1.66)	(0.51)	(0.02)	(1.74)	(0.57)	(1.64)	(0.52)
fourth year	-0.007	-0.005	0.002	0.0003	-0.004	-0.002	-0.005	-0.004
	(1.92)	(1.13)	(0.51)	(0.07)	-(0.84)	(0.35)	(1.08)	(0.67)
fifth year	-0.009	-0.005	-0.0002	0.001	-0.006	-0.002	-0.004	-0.002
	(2.61)	(1.14)	(0.05)	(0.25)	(1.51)	(0.51)	(1.08)	(0.50)
tenure dummies								
first year		-0.028		-0.01		-0.037		-0.022
		(5.79)		(2.1)		(5.86)		(2.27)
second year		-0.019		-0.013		-0.029		-0.023
		(4.32)		(2.78)		(5.23)		(2.77)
third year		-0.007		-0.002		-0.009		-0.008
		(1.5)		(0.37)		(1.71)		(1.07)
fourth year		-0.002		0.003		-0.003		-0.002
		(0.35)		(0.72)		(0.69)		(0.25)
fifth year		-0.004		-0.001		-0.005		-0.002
		(0.96)		(0.18)		(1.05)		(0.51)

Table 6. Distribution of Principal Fixed Effects by Student Demographic Characteristics

	Without school fixed effects	With school fixed effects
1. Income		
low income	0.044	0.042
not low income	0.010	0.054
2. Race-ethnicity		
Black	0.081	0.047
Hispanic	0.043	0.046
White	-0.004	0.047
3. Math score quartile		
Bottom	0.009	0.010
2nd	0.028	0.043
3rd	0.039	0.064
Top	0.043	0.079
All Students	0.029	0.048

Figure 1. Experience of Principal by Student Demographics of School
(six or more years experience v. less than 6 years experience)



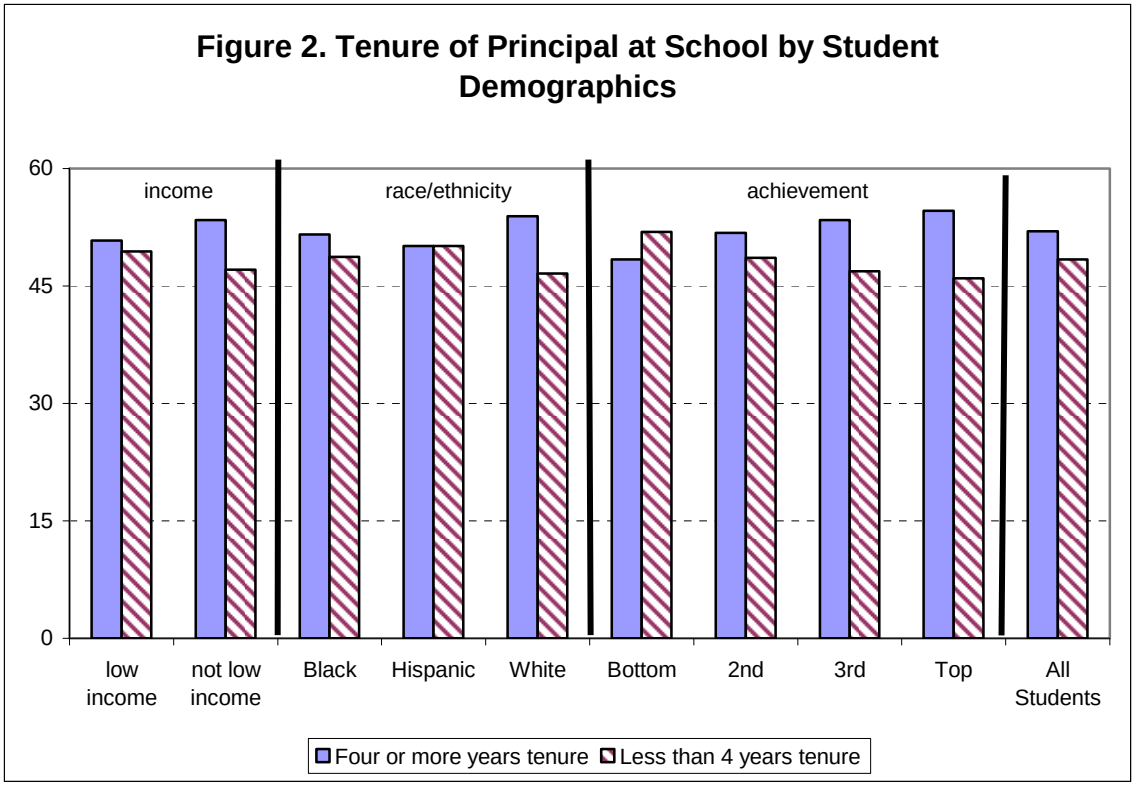


Figure 2. Tenure of Principal at School by Student Demographics
60
45
30
15
0
income
race/ethnicity
achievement
low income
not low income
Black
Hispanic
White
Bottom
2nd
3rd
Top
All Students
Four or more years tenure
Less than 4 years tenure

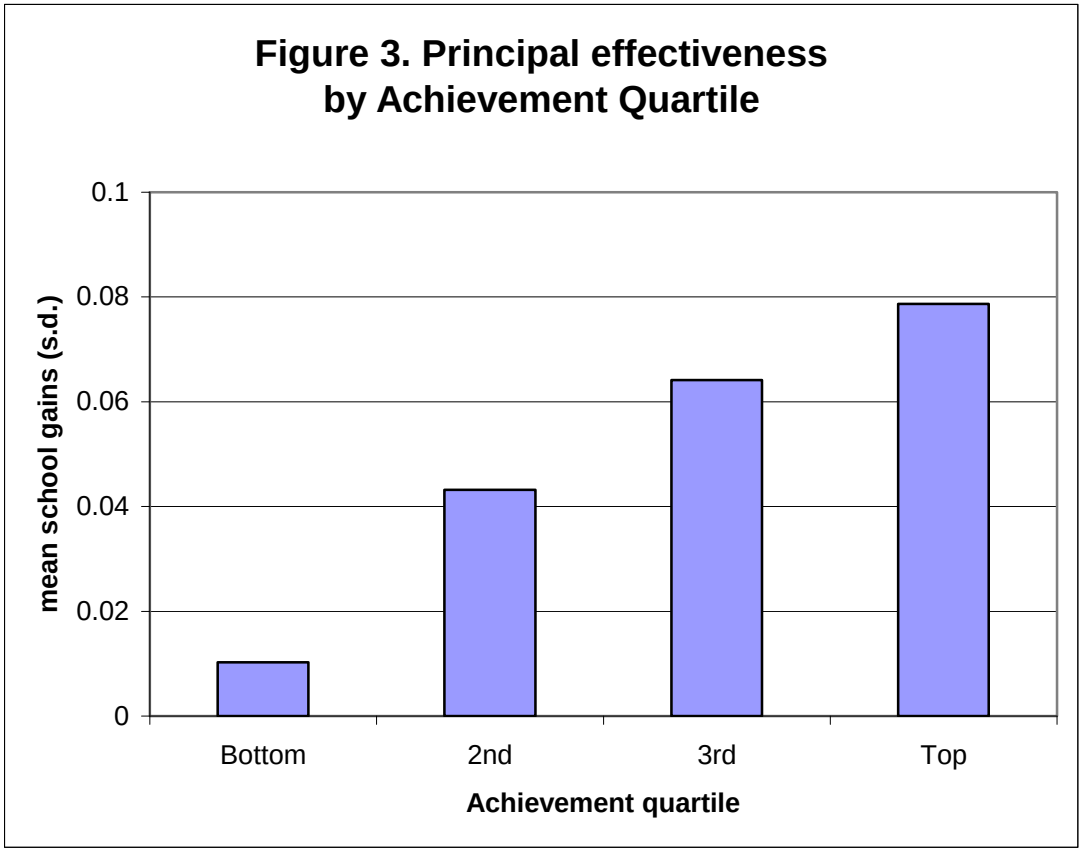


Figure 3. Principal effectiveness
by Achievement Quartile
0.1
0.08
0.06
0.04
0.02
0
mean school gains (s.d.)
Bottom
2nd
3rd
Top
Achievement quartile