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School Principals and School Performance

Damon Clark,
Paco Martorell,
and Jonah Rockoff

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Damon Clark
University of Florida

Paco Martorell
RAND

Jonah Rockoff
Columbia Business School

Corresponding authors: Damon Clark, University of Florida, Email: damon.clark@cba.ufl.edu; Paco Martorell, RAND, Email: paco@rand.org; Jonah Rockoff, Columbia Business School, Email: jonah.rockoff@columbia.edu

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CALDER, The Urban Institute
2100 M Street N.W., Washington, D.C. 20037
202-261-5739 • www.caldercenter.org

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Abstract

We use detailed data from New York City to estimate how the characteristics of school principals relate to school performance, as measured by students' standardized exam scores and other outcomes. We find little evidence of any relationship between school performance and principal education and pre-principal work experience, although we do find some evidence that experience as an assistant principal at the principal's current school is associated with higher performance among inexperienced principals. However, we find a positive relationship between principal experience and school performance, particularly for math test scores and student absences. The experience profile is especially steep over the first few years of principal experience. Finally, we find mixed evidence on the relationship between formal principal training and professional development programs and school performance, with the caveat that the selection and assignment of New York City principals participating in these programs make it hard to isolate their effects. The positive returns to principal experience suggest that policies which cause principals to leave their posts early (e.g., via early retirement or a move into district administration) will be costly, and the tendency for less-advantaged schools to be run by less experienced principals could exacerbate educational inequality.

School Principals and School Performance

Introduction

State and local school accountability systems have become widespread, in part due to requirements of the federal No Child Left Behind legislation. The focus on schools, as opposed to school districts or teachers, presupposes that school-level policy decisions matter. These decisions are, in large part, determined by school principals, who have an important influence on the composition of the school workforce and course content, and who are responsible for monitoring the quality of instruction delivered by teachers. However, in contrast to the large literature on teacher quality (Rivkin, Hanushek, and Kain 2005; Rockoff 2004; Harris and Sass 2006; Kane, Rockoff, and Staiger 2008; Buddin and Zamarro 2009), few studies have addressed whether principals impact school performance and, if they do, which principal characteristics determine principal effectiveness.

The literature on principals is sparse in part because of the difficulties faced in defining and measuring principal effectiveness and in part because of the paucity of high-quality data on which convincing empirical strategies can be based. In this paper we present new evidence on the relationship between principal characteristics and school performance using data from New York City Department of Education (hereafter NYC). There are a number of reasons why NYC is an especially attractive setting to study these relationships. First, it is the largest school district in the nation and employs well over 1,000 principals. Second, nearly all of its principals are hired from within the school system, and we have detailed information on their entire career as educators in NYC. Third, for elementary and middle schools, on which we focus, we have data on student outcomes covering eight school years, which allows us to examine how school performance varies over a principal's career and how it changes when schools change principals. Fourth, since our data is at the student level, we can estimate models of school performance that control for student characteristics in a very flexible manner. A fifth reason to be interested in NYC is that, in 1991, the city implemented an unusual policy that generated quasi-experimental variation in principal characteristics across schools. We describe this program in

detail here, though our analysis of this experiment is ongoing.

We use a variety of empirical strategies to estimate the relationship between principal characteristics and school performance. These strategies are non-experimental, and identify the causal effects of principal characteristics on school performance only under certain identifying assumptions which we make clear below. These non-experimental estimates are less informative than would be experimental estimates of the same parameters. Nevertheless, we see two reasons why they mark an important step forward for the literature on school principals. First, principal candidates are not randomly assigned to schools and it is difficult to conceive of natural experiments that will generate the quasi-random variation in principal characteristics required to identify causal effects without strong identifying assumptions. Second, our understanding of the relationship between principal characteristics and school performance is extremely limited. In our review of the related literature, we found few studies of whether principals influence school performance, and few convincing studies of the impact of specific principal characteristics such as education and experience.[1] Non-experimental estimates of these relationships can therefore provide valuable new information and inform policies relating to principal hiring and compensation.

The main strategy that we use to estimate the relationship between principal characteristics and school performance exploits principal turnover within the same school (i.e., controls for school fixed effects). By comparing different principals working at the same school, we can hold constant all persistent differences across schools. In addition, to control for the possibility that different types of principals attract or are attracted to different types of students, we also include controls for pre-determined student characteristics (e.g., poverty and race), both at the individual and school level. For middle school students, these controls include the test scores they most recently obtained in elementary school.

Our analysis leads to three main findings. First, we find little evidence of any relationship

[1] Studies of principals in Texas (Branch, Hanushek, and Rivkin 2008) and in British Columbia (Coelli and Green 2009), are two exceptions which we describe below.

between school performance and the selectivity of a principal's undergraduate or graduate institution. We also find little relationship between performance and a principal's prior work experience, with the exception that, among very inexperienced principals, school performance is higher among those that were previously assistant principals at their current school. Second, we find a positive relationship between principal experience and school performance, particularly for math test scores and student absences. The experience profile is especially steep over the first few years of principal experience. Third, we find mixed evidence on the relationship between principal training and professional development programs and school performance, with the caveat that the selection and assignment of principals participating in the NYC training programs make it hard to isolate their effects.

We draw three conclusions from these findings. First, in regard to principal selection, our results suggest that characteristics that can be directly observed on a resume – such as the selectivity of the school from which a candidate received their master's degree – are probably less important than characteristics that cannot, such as leadership skills and motivation. Second, in regard to principal retention, the positive returns to principal experience suggest that policies which cause principals to leave their posts early (e.g., via early retirement or a move into district administration) could lower school performance. Third, our results suggest that high rates of turnover in less-advantaged schools could exacerbate educational inequality. Principal training could improve the performance of new principals and further enhance the performance of more experienced principals, but determining the effects of training is complicated by non-random selection of individuals into these programs.

Policy and Evidence

Principal Promotion and Retention Policies

Traditionally, educators seeking promotion to principal positions were required to serve time as teachers and assistant principals and accumulate the academic credits necessary to obtain the relevant certification. As discussed by Ballou and Podgursky (1993), this model occupies a middle ground

between a system with even greater "professionalization" – in which, among other things, individuals trying to become principals might be required to obtain doctorates in education – and a system with much lower entry barriers, in which potential principals could be promoted from non-traditional backgrounds, without formal education credentials but with management training and, perhaps, private sector experience.

In recent years, school systems such as New York City have changed hiring procedures in ways that change the pool of individuals who become principals. These changes are based on the notion that principals need not have served the district for a long period of time in order to be effective leaders, and that talented educators should be promoted when they are considered ready to lead schools. In NYC, this has led to a dramatic change in the age profile of principals. For example, more than 130 of the roughly 1000 elementary and middle school principals in NYC are under the age of 35, up from less than 30 in 2002 (authors' calculation based on data described below). A significant fraction of the younger principals in NYC also have bachelor and master degrees from Ivy League universities such as Columbia and Harvard, and we examine whether the selectivity of principals undergraduate and graduate institutions are predictive of school performance.

New York City policies have also supported the idea that educators with leadership talent can be transformed into effective principals via intensive principal training programs. The most prominent of these is the Aspiring Principals Program (APP), a 14-month intensive training program designed to prepare educators for principal positions. Others in operation over our sample period include programs such as "New Leaders for New Schools", "Tomorrow's Principals" and the "Bank Street Academy". In the school year 2006-2007, more than one half of newly recruited NYC principals had passed through one of these training programs.[2]

While policy relating to principal's subsequent careers has provoked less comment, there is an

[2] All individuals who became principals during our sample period must have completed state certification requirements via completion of a state approved program of study. Thus, principals trained in a program such as the APP will be compared primarily to principals who fulfilled certification requirements on their own initiative as well as the small number of principals who received certification via some other formal training program.

ongoing debate surrounding the optimal length of a principal's career, clearly relevant to policies relating to principal salary structure and retirement incentives. Joel Klein, New York City's Schools Chancellor, is on record as saying he would like good principals to stay in schools for eight to ten years (Gootman and Gebeloff 2009), significantly longer than the current median principal experience in NYC. The assumption that more-experienced principals are more effective also raises concerns that—as has been shown for teachers, e.g., Hanushek, Kain, and Rivkin (2004)—principal turnover may be higher at schools serving more disadvantaged students, and that, when experienced principals move within a district, they move to schools serving more advantaged students. We provide empirical confirmation that these patterns exist in NYC.

Evidence on Principal Characteristics and School Performance

There are several strands of literature concerned with the relationships between principal characteristics and school performance. One set of studies relates raw test scores to principal characteristics (Blank 1987; Eberts and Stone 1988; Heck, Larsen, and Marcoulides 1990; Brewer 1993; Heck and Marcoulides 1993; Hallinger and Heck 1996; Waters, Marzano, and McNulty 2003; Witziers, Bosker, and Kruger 2003). These studies are limited in that they consider only a narrow range of principal characteristics, use only a small sample of schools, and do not adequately control for factors that confound the relationship between achievement and principal characteristics such as student demographics. A second strand of this literature examines other student-based outcomes such as attendance (Blank 1987) and student engagement (Leithwood and Jantzi 1999). These outcomes are also likely to be strongly influenced by student composition, making it difficult to draw conclusions from these studies without strong identification assumptions. Moreover, it is also unclear whether these measures represent inputs or outputs.

A third strand of the literature measures school performance using teacher-based outcomes such as teachers' evaluations of school principal performance (Ballou and Podgursky 1993) and teacher

mobility/attrition (Gates et al. 2006). Teacher ratings can overcome some of the limitations of student-based measures, to the extent that teachers are aware of factors such as the socio-economic background of the study body, but these evaluations are subjective, and may not be strongly related to student outcomes.

These three sets of papers generate mixed evidence in regards to the relationship between school performance and principal characteristics. In terms of principal education, both Eberts and Stone (1988) and Ballou and Podgursky (1993) find a negative correlation between school performance and principal education, as measured by advanced degrees and graduate training. One explanation, advanced by Eberts and Stone (1988), is that highly-educated principals are placed in low-performing schools. Both Eberts and Stone (1988) and Ballou and Podgursky (1993) find a positive association between years of teaching experience and school performance although Brewer (1993) finds no such correlation. Evidence on the impacts of principal experience is also mixed: Eberts and Stone (1988) find positive effects while Ballou and Podgursky (1993) find no correlation. These mixed results could reflect differences across outcomes, controls, or sample characteristics. None of these studies have addressed whether principals that participated in training programs improve school performance, in part because these programs are a relatively recent phenomenon.

This paper constitutes a fourth strand of this literature, one that analyzes these relationships using detailed administrative principal data matched to detailed administrative student data. To our knowledge, only Branch, Hanushek, and Rivkin (2008) have conducted a similar analysis. Focusing on Texas, they document changes in the composition of principals and patterns of principal mobility. They then estimate school performance models that include student characteristics and school characteristics, principal and school fixed effects and principal experience and tenure. Their interest is in the relationship between principal mobility and principal effectiveness (as measured by the estimated principal fixed effects) and in the relationship between principal experience and school performance. We return to their findings in Section 6, and compare their results with our own.

Three recent papers have addressed more specific questions relating to principals. Coelli and Green (2009) estimate the variation in principal effectiveness across schools. Their approach—a version of the method Rivkin, Hanushek, and Kain (2005) use to analyze teacher impacts—ignores specific principal characteristics such as education and experience and focuses instead on the correlation between within-school performance variation and within-school principal turnover: under some assumptions, the strength of this correlation is increasing in the variation in principal effectiveness. One important assumption is that student sorting is unrelated to principal effectiveness. If that assumption is violated (e.g., if effective principals attract high-achieving students to a school), this method will over-state the variation in principal effectiveness. Their results suggest some role for principal quality in determining students' standardized exam scores, but they find little impact on graduation rates. Cullen and Mazzeo (2008) examine the relationship between school performance and the principal's future wages. They find that strong performance is associated with increased future wages, which suggests that the principal labor market may provide effective incentives for principals.

Finally, Corcoran, Schwartz, and Weinstein (2009) evaluate the NYC Aspiring Principals Program discussed above. They find evidence that APP principals enter schools whose performance is on the decline, and that they improve school performance on standardized tests, particularly in English, after about three years. We discuss this study in more detail below after presenting our findings relating to the APP program.

Identifying the Effects of Principal Characteristics

In this section we describe the conceptual issues surrounding the empirical identification of the effects of principal characteristics. We begin with a simple model where school performance is a function of principal characteristics and a random disturbance term (i.e., postpone any role for teachers and students). Specifically, assume the performance of school i at time t (Y_{it}) can be written as a function of a time-invariant observed principal characteristic such as post-graduate education (PC_i), a time-varying

observed principal characteristic such as principal experience (PE_{it}), a time-invariant unobserved principal characteristic which we call ability (PA_i), and a random disturbance term (e_{it}):

$$(1) \qquad Y_{it} = b_o + b_1 PC_i + b_2 PE_{it} + PA_i + e_{it}$$

All of the claims made about identification of this three-variable model extend to the case in which we have many observable principal characteristics (experience as an Assistant Principal, principal training and so on) and many unobservable dimensions (work ethic, leadership skills and so on).

Since principal ability is unobserved, a regression of the outcome on principal education and experience would identify the causal effect of principal education plus an ability bias generated by any correlation between education and unobserved ability (conditional on experience) and the causal effect of principal experience plus an ability bias generated by the correlation between experience and unobserved ability (conditional on education). All of the strategies discussed below will generate estimates of principal characteristics that are potentially confounded by these types of ability biases.

A more realistic model of school performance would allow for the influence of factors such as average student background characteristics (X_{it}), average teacher quality (T_{it}) and the quality of school facilities (F_{it}):

$$(2) \qquad Y_{it} = b_o + b_1 PC_i + b_2 PE_{it} + b_3 X_{it} + b_4 T_{it} + b_5 F_{it} + PA_i + e_{it}$$

Since this equation refers to school-level achievement, we can interpret the influence of the school peer group as comprising the influence of students' own background characteristics plus any peer effects in operation. In this framework there are two additional sources of potential bias that arise from the sorting of students and principals to schools. Student sorting biases would arise if, for instance, parents that place a high value on education seek out schools with more-educated and more-experienced principals. School sorting biases would arise if, for example, more-educated and more-experienced principals move to schools with better facilities.

To deal with these types of sorting biases we estimate models that include school fixed effects. These will capture the effects of any school characteristics that are time-invariant over our sample period. In models that include school fixed effects, estimates of the relationship between principal characteristics and school performance are identified via a comparison of different principals working in the same school.[3] Since student characteristics may vary over the sample period, we also control for an extensive set of student characteristics. For middle school students, these characteristics include scores on tests taken while in elementary school.

Even after controlling for school fixed effects and student characteristics, our estimates will still be subject to ability biases. For example, among the set of principals that have worked at a particular school, those with most experience could also be the most able. Such a relationship would arise if principal retention decisions are based partly on principal ability. However, whether we want to correct for these ability biases depends on the specific research question under consideration. For both time-varying principal characteristics (such as experience) as well as time-invariant characteristics (such the quality of one's post-graduate degrees), there are two questions about the effect of a characteristic X we might like to answer:

a) What is the effect of replacing a principal who has $X=xk$ (i.e., xk years of experience) with a principal who has $X=xl$?

b) What is the effect of *X (i.e., years of experience)* on the performance of a principal?

With regard to principal selection policies, the first question is arguably more interesting. To comprehend this, consider a school district administrator making a hiring decision. Assuming their goal is to hire the most effective principal, they will be interested in knowing whether one candidate will perform better in a given school than another candidate. Consequently, they will want know if a given

[3] While the addition of school fixed effects is very helpful in mitigating this bias, identification of the relationship between school performance and time-invariant principal characteristics (e.g., prior experience as an assistant principal) will be based only on performance of schools which changed principals at least once during our sample. For example, these estimates are unlikely to be based on schools that opened near the end of our sample period since these schools will typically only have had one principal.

characteristic, like whether they graduated from an Ivy League school, is useful for predicting how effective they will be as a principal. For this question, the ability "bias" is part of the effect of interest.

In contrast, with regard to the cost-effectiveness of policies that directly affect the acquisition of principal characteristics, the second question is more appropriate. For example, if experience has no causal impact on performance, policies that lengthen the careers of all principals (both high and low ability) will be ineffective.

In this paper we focus on the first of these questions, in large part because the second is extremely difficult to answer in a non-experimental setting. For example, the effects of time-invariant characteristics (such as education) on principal effectiveness can only be identified by variation across principals, and without (quasi) random assignment, they are likely correlated with unobserved principal characteristics. The effects of experience (or, more generally, time-varying characteristics) can be identified via "within-principal" comparisons, but these can be problematic. For example, if there is selective attrition, such that not all of the principals with three years of experience stay in the system for a fourth year, the estimated return to the fourth year of experience may be "local" to this subgroup of stayers. This may be an interesting parameter for some purposes, but may not be a good guide to the return to an additional year of experience for a randomly chosen principal with three years of experience.

Another important issue is how the inclusion or exclusion of other school-level inputs into Equation 2 will affect the interpretation of the coefficient estimates on principal characteristics. For example, if teacher characteristics were completely under a principal's control, then a specification that included teacher characteristics might understate the relationship between principal characteristics and school performance. Intuitively, controlling for these characteristics would shut down some of the channels through which principals affect school performance. On the other hand, we probably would want to control for the quality of student background characteristics, since principals cannot control important factors like students' socio-economic status. If these are uncorrelated with principal

characteristics then controlling for them will generate more precise estimates; if these are correlated with principal characteristics, then controlling for them will help address biases from sorting.

Finally, we follow the earlier literature on identifying the impact of teaching experience from variation within teachers (Rockoff 2004), and assume that the benefit to additional experience is negligible after the first several years of a principal's career. By treating principals with experience above some level E^* as having the same amount of experience, we eliminate the problem of collinearity. In addition, the plausibility of this identifying assumption can be checked by testing whether the estimated marginal benefit of experience approaches zero as E_{it} approaches E^*.

To summarize, our main strategy for identifying the relationship between school performance and principal characteristics will be to regress student performance on principal characteristics, student background characteristics, school characteristics and school fixed effects. This strategy will identify the causal effects of these characteristics plus the relevant ability biases provided that the set of student and school controls (and fixed effects) deal with school and student sorting. As noted above, it is not plausible to assume that the principal assignment process is random, and these non-experimental estimates may not control for all biases due to school and student sorting. It is nevertheless plausible to suppose that these estimates can shed important new light on the relationship between school performance and principal characteristics, particularly given the paucity of prior evidence. In ongoing work, we exploit a natural experimental to assess the extent to which these biases affect our estimates of the impacts of principal experience.

Data

In order to provide credible evidence on the relationship between principal characteristics and school performance, detailed information on each principal's education, training, work experience, and other traits must be collected. This can be difficult even if principal recruitment is entirely within-district, since some principals may have started their careers decades ago. When a district recruits principals externally, it is almost impossible.[4]

Second, data are required on school performance, ideally measured as student achievement. Until recently, systematic testing of students in U.S. schools at broad geographic levels was uncommon, so that data that allow for inter-school comparisons using multiple years of performance are hard to come by. Third, for estimated relationships between performance and principal characteristics must account for differences in factors outside of principals' control that affect performance and are correlated with principals' characteristics. Finally, since school principals are a school-level treatment, researchers wishing to identify robust relationships between performance and characteristics require data containing relatively large numbers of schools.

The data employed in this paper meet all of these requirements.[5] First, we have information of the employment histories of all individuals who worked as principals in New York City public schools since 1982. This allows us to generate accurate measures of experience as a principal, assistant principal, and teacher. The data also include the school where a principal received her bachelor's and master's degrees. We use this information in conjunction with information on the median SAT scores of undergraduate students at that institution to measure the selectivity of the schools that a principal attended.[6]

[4] In theory, one could use surveys to collect this information. However, survey responses are likely to contain less accurate information than administrative records and are likely to create the potential for bias due to non-response, particularly if one attempts to collect data on principals who may have already retired.

[5] More information about the data sets described here is provided in the Data Appendix.

[6] These data were provided to us by Caroline Hoxby. As required by law, every principal in our dataset has a master's degree; hence we do not examine the relationship between master's degrees and school performance.

Additionally, we have information on whether principals participated in special training programs, and we focus on two programs in our analysis. The NYC Leadership Academy's Aspiring Principals Program (APP) is a "leadership development program that uses teamwork, simulated-school projects and job-embedded learning opportunities to prepare participants to lead instructional improvement efforts in New York City's high-need public schools."[7] The first APP graduates began as principals in the school year 2004-05; by 2007, around 10 percent of all NYC principals were graduates of this program.

In addition to the APP, a smaller number of principals received training through other programs (e.g., New Leaders for New Schools). However, the number of principals trained through these programs is too small for us to estimate their relationship to school performance with reasonable precision.[8] When we have information on a principal's participation in one of these programs, we control for it in our analysis but do not report these coefficient estimates.

We also look at principals who participated in the Cahn Fellows program. This is "designed to support the growth of exemplary school leaders" by "recognizing outstanding NYC principals and providing them with opportunities for professional, intellectual and personal growth." Thus, the Cahn Fellows program is quite different from the APP or other principal training programs; it is a professional development program that works with sitting principals with four or more years of experience in high performing schools, and its focus is on both recognition and training. The first group of Cahn fellows was selected in the 2003-2004 school year. Examining the Cahn Fellows program is important because it sheds light on whether professional development programs for highly experienced and successful principals can help them further improve student performance. It is also interesting to

[7] See http://www.nycleadershipacademy.org/aspiringprincipals/app_overview for this and more information.
[8] Almost two percent of principals were trained via the New Leaders for New Schools program, but about half of them served in high schools (for whom we have no test score data), and those in elementary and middle schools were typically the only principal at the school during our sample period, leaving only a handful of cases identified under our school fixed effects approach. In contrast, about 60 Cahn Fellows and 120 Aspiring Principals Program graduates are included in our analysis.

investigate whether principals chosen to be Cahn Fellows are leading schools that are outperforming comparable schools. If they are, then it would suggest that the selection process used to pick Cahn Fellows may be a useful in identifying effective principals.

Our data on school performance span the school years 1998-99 through 2006-07. Our primary measures are standardized tests in math and English taken by grade 3-8 students in the roughly one thousand elementary and middle schools in NYC. In order to avoid any issues related to changes in test design, we normalized the exams' "scaled scores" by year and grade level to have a mean of zero and a standard deviation of one. Thus, our estimates below are scaled in terms of student level standard deviations of achievement. Additionally, while test scores in New York improved over this time period, our estimates are based on variation in relative performance within the school district.

In addition to student exam scores, the data include information on other "intermediate" outcomes. For students, these include days absent and days suspended, and for teachers they include days absent and retention. While student achievement test scores are relatively common measures of school output, impacts on these other outcomes are less straightforward to interpret. On the one hand, these can be seen as inputs into future school performance: fewer suspensions might reflect less disruption in the classroom; fewer teacher absences might reflect higher levels of teacher job satisfaction. On the other hand, fewer suspensions may reflect a lax approach to student discipline or a change in the likelihood of reporting an incident rather than a change in student behavior. Similarly, fewer teacher absences may be associated with lower teacher performance, to the extent that substitute teachers perform better than regular teachers that are ill. Nevertheless, these intermediate outcomes provide complementary evidence to our analysis of student achievement.

To control for school sorting biases, we identify the relationship between school performance and principal characteristics using school fixed effects (i.e., comparing principals at the same schools). As such, it is worth noting that, over this nine year period, we observe over one thousand observations on schools experiencing a principal transition. To control for student sorting biases we include detailed

controls for the background characteristics of tested students, and the background characteristics of all students in the tested grades within the school during the year.

Descriptive Statistics

In this section we present some descriptive statistics on the principals in our sample. Table 1 shows evidence on the trends in the background and experience of NYC principals. As seen in the left-hand columns, over the twenty-year period from 1987 to 2007, the most dramatic trends were in principal demographics. The fraction of female principals rose from 33 to 68 percent, and the fraction of non-white principals rose from 28 to 49 percent. Similar changes in principals' gender occurred over this period at the national level, but the changes in minority representation nationally were much smaller.[9] By comparison, changes in average principal experience and the fraction of principals that worked as an assistant principal in the same school were quite small.

The right-hand columns of Table 1 report trends in the composition of new principals in New York. The first of these columns reports the number of new principals hired. This increased between 1987 and 2005, as the number of schools increased, and was especially high in 1992. This 1992 figure reflects the large number of new principals hired to replace the large number of principals taking advantage of the 1991 retirement incentive scheme. We discuss this scheme in more detail in Section 7. The remaining statistics on new principals can be seen as leading indicators of the trends discussed above.

Table 2 describes the increase in the fraction of principals that completed one of the formal training or professional development programs observed in our data. At the beginning of the period for which we have school performance data, almost no principals had completed such a program, but a significant fraction of principals had done so by the school year 2006-07. Over one in ten principals had been trained through the APP program, and nearly 4 percent had been participated in the Cahn Fellows

[9] Nationally, the fraction female rose from 25 to 50 percent, while the fraction of non-white principals rose from 13 to 19 percent (Fiore and Curtin (1997), Battle (2009)).

program.

Table 3 presents a broad-brush description of the relationship between principal characteristics and the characteristics of students in the schools in which they work. These tabulations are significant for the empirical analysis presented below since, as noted above, estimates of the performance impacts of principal characteristics will be biased if they do not account for school and student sorting. The table is based on principal-school observations pooled across all of the school years for which we have matched student-school data (1998-99 through 2006-07). The table reveals a strong relationship between principal experience and the fraction of non-white students and an especially strong relationship between principal experience and average (contemporaneous) test scores. If this relationship reflects students sorting based on factors that are unobserved in our data, we will over-estimate the return to principal experience. On the other hand, principal experience does not appear to be strongly related to other measures of school advantage such as the fraction of students receiving free or reduced-price lunch or the fraction who are English language learners. This could be because sorting is strongest with respect to test scores or because principal experience has a causal impact on test scores.

It is interesting to consider the processes that might give rise to the relationship between principal experience and student background. For example, suppose principals are, on average, less likely to leave advantaged schools compared with disadvantaged schools. Even if job candidates for principals were randomly assigned among the schools with principal openings, this process would eventually generate a positive correlation between principal experience and student background. There might also be a tendency for principals to move up a career ladder, switching to schools serving more advantaged students as they acquire more experience. This would reinforce the effects of any differential separation behavior.

Both of these tendencies can be seen in Table 4, which describes the schools from which principals separate and, if a transfer occurs, the schools to which they move. Of around 1,200

separations, only 12 percent involve a transfer to another elementary or middle school in NYC; the remaining transitions (88 percent) are predominantly to retirement or a job outside the NYC department of education. The numbers in the first column reflect the relationship between principal separation and average student test scores: principal turnover is lower in schools with average test scores in the highest quartile (22 percent) than in schools with average test scores in the lowest quartile (30 percent). The numbers in the remaining columns show that there is a small tendency for principals who move within the school system to move to schools with higher test scores. Of principals moving to a new school in our sample, roughly 50 percent stay in the same quartile of average test scores, roughly 30 percent move to a higher quartile, and roughly 20 percent move to a lower quartile. In other words, principals leaving lower-SES schools are more likely to transfer to higher-SES schools (conditional on transferring to an in-sample school).

Provided that school sorting is in relation to persistent school characteristics, we can obtain unbiased estimates of the relationship between principal characteristics and school performance by comparing school performance across principals working at the same school (i.e., using school fixed effects). With this strategy in mind, Table 5 characterizes experience differences associated with principal transitions within a school. We group the "prior" principals into those that had less than four years of experience, between four and six years of experience, and seven or more years of experience. The "new" principals are grouped in the same way, except that we include an extra category for principals in their first year (i.e., zero experience). The table shows the distribution of the new principal's experience conditional on the experience of the prior principal. The results indicate that, across all levels of experience of the prior principals, the vast majority of new principals are first-year principals (i.e., they have not worked as a principal in another school). This is noteworthy because if new principals were assigned to schools randomly, the distribution of the new principal's experience would be the same irrespective of the prior principal's experience. This is roughly what the patterns in Table 5 show, although this does not imply that new principals are chosen at random.

Results from Regression Analysis

In this section we report our estimates of the relationship between principal characteristics and school performance. Table 6 reports our estimates of the relationship between principal characteristics and math and English test scores. The sample pools all students in grades in grades 3-8. For both math and English scores, we present estimates from two models. The first model includes extensive student characteristics, school characteristics, and school zip code fixed effects. These controls are included to mitigate bias from the possible sorting of high-achieving students to principals with certain characteristics. The second model replaces zip code fixed effects with school fixed effects. These estimates identify the relationship between principal characteristics and school performance by comparing school performance among different principals at the same school, thereby controlling for any time-invariant but unobservable school factors, including average unobservable student characteristics.

The estimates reported in the first column of Table 6 reveal four aspects of the relationship between principal characteristics and math test scores. First, the estimates suggest that math test scores are unrelated to a principal's educational credentials, as measured by the selectivity of the schools from which the principals received their MA and BA degrees.[10] The BA and MA estimates have different signs and neither is statistically distinguishable from zero. Second, the estimates provide mixed evidence regarding the relationship between math test scores and principal training and professional development. Principals that become Cahn Fellows (but have not yet been selected and gone through the program) are associated with high-performing schools, which is not surprising given that they are selected in part due to a record of good performance. Post-program Cahn Fellows are associated with even higher school performance. This differential may reflect the causal effect of this program on school performance, although these estimates are still based on across-school comparisons. APP

[10] Since all principals have a master's degree, we do not attempt to estimate the relationship between these and school performance.

graduates are associated with low school performance. Given that these principals are selected to work in struggling schools, one would be concerned that our estimates are biased due to differences at the school level for which we do not control. We return to these points below.

These estimates would also suggest that math test scores are higher when the principal has more experience as either a teacher or an assistant principal at the school where he/she becomes principal. These estimates are however small, and are on the margins of statistical significance.[11] Finally, the estimates suggest that math test scores are increasing in principal experience at the current school. There is a monotonic relationship between years as a principal and math test scores such that, other things equal, principals with three years of experience are associated with an increase in math scores of 0.04 standard deviations, while principals with five or more years of experience are associated with math scores 0.06 standard deviations higher than principals in their first year. As discussed below, this experience differential is around twice as large as that reported Branch, Hanushek, and Rivkin (2008) using similar models estimated using Texas data.

The addition of school fixed effects has a noticeable effect on our estimates, suggesting that some estimates from the specification with zip code fixed effects may be biased due to the non-random matching of principals and schools. First, the addition of school fixed effects eliminates the significant relationship between math scores and prior experience as a teacher or assistant principal at the current school. It also substantially weakens the relationship between math scores and the APP, supporting the view that these estimates were likely biased by placement procedures. The coefficient on Aspiring Principal Program graduates shrinks from 0.081 to -0.045 standard deviations, consistent with their placement in difficult schools, though it is still statistically significant. Note that the addition of school fixed effects does not ensure that bias is removed completely, since APP graduates may be placed in

[11] We also estimated specifications that included total experience as a teacher or assistant principal instead of experience at the principal's current school. The effects of overall experience were estimated to be even smaller and not statistically significant than the results reported in Table 6. We focus on prior experience at the current school for the remainder of our analysis.

schools in which performance is on a declining trend. We investigate this further under the section entitled: *Additional Analyses of Prior Experience and the Aspiring Principals Program.*

Turning to the coefficients on the Cahn Fellows program, we estimate the difference in school performance between Cahn Fellows and other principals who worked in their school to be close to zero prior to their selection in to the program. In other words, we cannot reject the hypothesis that Cahn Fellows come from good schools but were not more effective than other principals prior to their selection. However, there is a marginally significant (p-value = 0.16) positive effect (0.038 standard deviations) on Cahn Fellows in years after selection into the program.

The addition of school fixed effects has little impact on the principal experience estimates, which continue to suggest that experienced principals are more effective than principals in their first year. The estimates suggest that experience beyond four years has only very small effects on school performance, in line with our identification assumption. The magnitude of these estimates also suggests that the impact on math test scores for experienced principals who participate in the Cahn Fellows program is roughly the same as the effect of a first-year principal acquiring five years of experience.

Overall, the math test score results in Table 6 suggest there is no significant relationship, on average, between school performance and pre-principal experience or the selectivity of a principal's undergraduate and graduate institution. We find a positive relationship between school performance and experience as a principal, while estimates of the impacts of principal training and professional development are mixed. Estimates of the relationship between school performance and English are consistent with these conclusions, although the estimated experience profile is slightly flatter. One explanation is that English test scores are less sensitive to principals' actions than math test scores. This has been found elsewhere with respect to the impact of teachers (Rockoff 2004; Rivkin, Hanushek, and Kain 2005; Kane, Rockoff, and Staiger 2008) and is consistent with the estimates associated with other principal characteristics, which are typically smaller for English than math.

Table 7 shows results from math achievement models estimated separately for elementary and middle schools. Splitting the sample in this way is interesting for two reasons. First, if test scores are more malleable in earlier grades, then one might expect principals to "matter" more in elementary schools. There is some empirical support for this view. For example, the association between principal experience and math scores is steeper in elementary schools than it is in the full sample, and the coefficients are actually larger in the specification that controls for school fixed effects. In contrast, the estimated experience profile for middle schools is much flatter. In the specification that controls for school fixed effects, experience has very little association with math scores.

A second reason for looking at elementary and middle schools separately is that almost all students in New York City switch schools between elementary and middle school. Thus, most middle school students have at least one prior score that is not influenced by the current principal. This makes it possible to compare the estimates from middle school models that do and do not control for pre-middle school test scores. The degree to which estimates from these two models are similar is indirectly informative about the validity of the identification assumption needed for the estimates in Table 6 to be causal (i.e., whether principal characteristics are correlated with unobservable determinants of student outcomes). Reassuringly, the estimates are not very sensitive to the inclusion of prior test scores.[12]

Table 8 presents our estimates of the relationship between measures of student behaviors and principal characteristics. We focus on student absences and student suspensions, the two behavior measures in our dataset. Estimates of the relationship between student absences and principal characteristics are consistent with estimates of the relationship between student test scores and principal characteristics. In the models with zip code fixed effects and school fixed effects, there is no evidence of a relationship between student absence and principal education or pre-principal experience, and mixed evidence on the relationship between student absence and principal training and professional development programs. Specifically, absences show no significant relationship with having a school run

[12] English achievement models (available from the authors) point to similar conclusions.

by one of the APP principals, but they are estimated to fall by -.29 absences per child (p-value = 0.15) in the years after a principal enters the Cahn Fellows program. There is clear evidence that student absences are decreasing in principal experience. The addition of school fixed effects flattens the estimated experience profile, consistent with principals gradually learning how to control student absence, perhaps because it takes time to put in place procedures (e.g., assigning personnel to find truant students) to reduce absences.

Estimates of the relationship between student suspensions and principal characteristics suggest that suspensions fall monotonically with principal experience. Additionally, suspensions are estimated to be higher with APP principals and lower with principals that have more pre-principal experience as a teacher/assistant principal in their school (though both of these associations may reflect changes in student behavior or changes in reporting practices). Overall, as revealed by the adjusted R-squared values, these models explain only a small fraction of the variation in student suspensions in the sample.

Next, we present results on teacher absences and turnover (Table 9). For ease of exposition, we restrict attention to specifications with school fixed effects. Of all the characteristics we examine, only pre-principal experience as an assistant principal in the current school is significantly related to teacher absences. Since principals that previously worked as an AP in their current school did so for 4.6 years on average, the coefficient of 0.033 implies that teacher absences are about 0.15 higher under principals who were previously an AP in their schools.

In the turnover regressions, we see a negative correlation between teacher turnover and principal experience. These estimates suggest that turnover rates are approximately 1 percentage point lower under a principal with five or more years of experience relative to a new principal. Again, the normative implications of these finding are unclear. Teacher turnover can have negative consequences for student achievement, since experienced teachers are, on average, more effective than new teachers (Rockoff 2004; Rivkin, Hanushek, and Kain 2005). However, experience is not the only determinant of teacher quality, and new principals may be more likely to force out teachers they believe are ineffective.

Equally plausible, however, is that new principals make changes that some teachers view negatively, resulting in voluntary departures.

Additional Analyses of Prior Experience and the Aspiring Principals Program

One surprising aspect of our baseline analysis is the lack of any strong systematic relationship between school performance and pre-principal experience as a teacher or assistant principal. As mentioned above, the fraction of principals who previously worked as a teacher or assistant principal in their school was roughly 10 and 20 percent, respectively. However, it is important to recognize that our specification restricted the coefficient on pre-principal experience to be the same across all principals. A more reasonable hypothesis is that prior experience might be beneficial for new principals, but might become less important as principals spend more time on the job.

To investigate this possibility, we categorized principals as being either inexperienced (in their first two years) or experienced (three or more years), and interacted this variable with measures of pre-principal experience. We also controlled for school fixed effects. Among inexperienced principals, experience as an assistant principal in the current school is positively correlated with school performance (test scores, absences and suspensions), although experience as a teacher is not. Among experienced principals, neither type of pre-principal experience appears useful. This suggests that hiring an assistant principal to fill a principal vacancy may be helpful, particularly in schools where principal turnover is high.[13] An alternative interpretation, however, is that if an assistant principal takes over as principal in the same school, this is an indicator of stable and well-functioning policies that make operation by a new principal easier.

We conclude our analysis of principal characteristics by taking a closer look at the schools that recruit their new principal from the APP. As mentioned above, in evaluating the performance of these

[13] When school performance is proxied with teacher-based measures, there is no systematic relationship between school performance and pre-principal experience for either inexperienced or experienced principals (results available upon request).

principals, one might worry that APP graduates are placed in schools that are not only low-performing but on a declining trend. We therefore estimate specifications that allow the coefficient on having an APP principal to vary in the two years before and the three years after the APP graduate is hired. For purposes of comparison, we include the same indicators for schools that transition to a new principal but do not hire their new principal from the APP. We limit our sample to schools that hired a new principal between 2004–05 and 2006–07, the years in which the APP graduates began to be hired. These results are shown in Table 11.

Figure 1 provides a graphical illustration of these estimates. Specifically, it shows predicted test score trajectories at schools that transition to an APP graduate and schools that transition to a principal trained through a more traditional route. The predictions assume that in both types of schools the old principal had at least five years of experience and the new principal had none. The drop in performance associated with the principal transition is not surprising: the new principals have no experience and we have shown that less experience is associated with lower school performance. More interesting are the trends leading into and away from this transition and the differences in these trends across schools that do and do not hire APP graduates. In particular, while both types of schools tend to experience a principal transition after a test score decline, graduates of the Aspiring Principals Program tend to take over schools that experienced a noticeably greater pre-placement decline. This suggests that APP graduates are placed in schools that are already on a downward trajectory. The graph also suggests that these relative performance trends continue beyond the principal transition: the performance drop associated with the transition is larger at the schools hiring an APP graduate, and these relative performance trends are not reversed until three years later, and then only for English.[14] These qualitative results are insensitive to whether we examine trajectories with respect to overall experience as a principal or experience as a principal within a school (which, for most principals, are the same

[14] Since the first cohort of Aspiring Principals entered school in 2004-2005, we cannot measure impacts beyond three years. Also, these estimates may be confounded by changes in the quality of principals produced in different program cohorts. For example, if the initial cohort of Aspiring Principals were better than those which followed, this might drive our finding that school performance improves somewhat in their third year.

thing).

It is worth noting that our regression specification attributes variation in school performance to the *current* school principal. However, like any new manager, new principals are likely to be constrained by prior policy decisions, e.g., most of their teachers were hired by someone else. This raises two interpretation issues. First, it is unclear whether one would expect APP graduates to be able to make substantive changes to their schools in the time horizon we examine. Second, if APP graduates are more likely than other principals to take over schools whose previous principal made very poor policy decisions, we may reasonably expect their schools to underperform in the short run relative to other schools with new principals. One could fully address this problem with exogenous variation in the assignment of APP graduates among a set of schools hiring a new principal, but this is not available.

The results of our analysis of APP principals are slightly different than those obtained by Corcoran, Schwartz, and Weinstein (2009). Specifically, they find that performance at schools run by APP principals improves within a year of the APP principal taking over – more quickly than our results suggest. There are several differences between the two studies that could account for these different findings. First, the two sets of estimates are based on different samples. Corcoran, Schwartz, and Weinstein (2009) analyze a subset of schools that comprise a "balanced panel" in order to conduct a longitudinal analysis of the programs impacts. Specifically, they focus on members of the first two cohorts of APP principals that remained in their school for three or more consecutive years, serving as a principal throughout this period, and a set of comparison principals selected using similar criteria.[15] Our sample includes all members of the first three cohorts of APP graduates hired by elementary and middle schools. In addition, their study period covers the 2002-03 through 200708 school years whereas our data ends in the school year 2006-07. Second, the two sets of estimates use different sets of controls. In particular, Corcoran et al (2009) use school-level data and do not control for any of the

[15] The first two cohorts of APP principals analyzed in Corcoran, Schwartz, and Weinstein (2009) became principals in the 2004-05 or 2005-06 school years. About 27 percent (32 out of 120) of APP-trained personnel who were placed as principals are excluded from the analysis (author's calculations based on Table 1 of Corcoran, Schwartz, and Weinstein (2009).

student-level variables controlled for here.

While it is tempting to focus on these differences, our studies have much in common. In particular, both studies show that APP principals are assigned to schools in which performance is below average and trending downwards, and both studies find evidence that schools run by APP principals do, eventually, show relative performance improvements. In our view, given the difficulties involved in estimating the causal effects of this program, it is not surprising that differences in sample and method could generate differences in the timing and strength of these improvements. Additionally, both studies estimate these effects imprecisely, due to the small numbers of principals trained in this program (e.g., there are only 88 APP-trained principals in the data used by Corcoran, Schwartz, and Weinstein (2009).

Discussion of Results

Our analysis suggests three main findings. First, we find little evidence of any relationship between school performance and principal education or pre-principal work experience. One exception is that, for inexperienced principals, we find a positive effect of having worked as an assistant principal in the same school. Second, we find a positive relationship between principal experience and school performance, particularly for math test scores and student absences. The experience profile is especially steep over the first few years of principal experience. Third, we find mixed evidence on the relationship between principal training and professional development programs and school performance, with the caveat that the non-random process by which program participants are hired by or selected from schools makes it hard to identify their effects. Our estimates suggest that when an experienced principal becomes a Cahn Fellow, school performance improves. On the other hand, our estimates suggest that when a school is assigned a principal from the APP, relative school performance does not improve (and may even drop) in the short run, but may improve in the longer run.[16] In addition to the problems

[16] Note that there were significant citywide gains in math and English achievement during our study period, particularly in the NYC schools serving poor students. Thus, students in schools led by APP principals were likely to have made absolute gains in achievement, but our findings suggest they were smaller than those experienced in schools led by new non-APP principals.

caused by non-random selection and assignment, our data on APP graduates is relatively limited—covering only three years and three cohorts—suggesting further study is necessary to gauge the merits of this training program for new principals.

The study most comparable to ours is Branch et al. (2008), which also uses panel data to study the relationship between school performance and principal characteristics. In the most comparable specification, in which they examine the relationship between principal experience and math achievement among grade 3-8 students, they estimate a return to experience around one half of the size of that estimated here. In particular, they estimate that relative to a first-year principal, a principal with six or more years of experience is associated with a 0.025 or a 0.017 increase in test scores, depending whether the specification includes school fixed effects. Our estimates suggest effects of 0.061 and 0.039.

There are several reasons why our estimates might differ from theirs.[17] First, the returns to experience might be higher in NYC. This would be the case if the NYC environment were one in which principal learning is more important. Second, ability biases might be larger in NYC (recall that both sets of estimates will be affected by ability biases). Ability biases would be larger in NYC if less able principals were more likely to quit or be terminated early in their career.

To get a handle on this last possibility, we estimated models that include principal-by-school fixed effects. If principals spend their entire careers in one school, these will identify the same parameter as that identified by the school fixed effects models (provided both are free of school and student sorting biases). If principals move schools, the two approaches will estimate slightly different parameters, although the difference between them should not be large.[18] As seen in Table 12, replacing

[17] One simple explanation is that a standard deviation of achievement among Texas students represents twice as much "true learning" as a standard deviation in NYC. This is highly unlikely; NAEP data show that variance in achievement within NYC and within Texas are both close to the national variance in achievement.

[18] The principal-by-school fixed effects models will identify the return to an additional year of experience in the same school, while the school fixed effects models will identify the average return to an additional year of experience (in the same school or in general). If much of the return to experience is school specific, then the principal-school fixed effects estimates may be higher. However, in practice this is unlikely to be important because few principals work in multiple schools.

school fixed effects with school-by-principal fixed effects generates slightly smaller point estimates (especially for English, where the experience effects become insignificant), although a statistical test could not distinguish between the two. This suggests that the NYC-Texas differences are unlikely to be driven by ability biases.

A third explanation for the steeper NYC experience profile is that the NYC estimates suffer from greater student and school sorting biases. For example, there may be more scope for successful NYC principals to sort into schools that are high performing in ways that cannot be controlled for using student characteristics. This explanation is difficult to address without exogenous variation in principal experience. In the next section, we describe a natural experiment that can help us assess whether the NYC estimates are driven by selection bias.

Do Inexperienced Principals Hurt School Performance: A Natural Experiment

An important finding to emerge from our analysis is the positive impact of principal experience, particularly over the first few years of principals' careers. Since this implies that new, inexperienced principals will, on average, hurt school performance, it has at least two implications. First, it implies that policies that lengthen principals' careers will, on average, improve school performance, since there will be fewer first-year principals. Second, it implies that a positive correlation between principal experience and student background may exacerbate inequality within the NYC education system.

Since this finding has important implications, we would like to be sure that it is not biased by student or school sorting. While our estimates are based on models that include school fixed effects, ruling out sorting on persistent school characteristics, they could be biased by sorting on transitory school characteristics or on student characteristics. For example, if a school is renovated halfway through the sample period, and if this attracts both higher performing students and a more experienced principal, we may falsely attribute this student-induced improvement to the more experienced principal. More generally, more-experienced principals may be attractive to parents of relatively advantaged students, perhaps because they suggest a greater degree of school stability. If our data do not capture

these characteristics, we will falsely attribute differences in student performance driven by these characteristics to the actions of the experienced school principal. This is a problem faced by all existing studies on the impact of principals on student outcomes.

In ongoing work, we examine principal experience using a natural experiment. The "Principal Retirement Incentive," introduced by NYC in 1991, aimed to help alleviate a budget crisis by inducing early principal retirement. Three aspects of this scheme make it an especially useful tool for identifying the effects of principal experience. First, the scheme induced many retirements: around 250 of NYC's 1,000 principals retired in 1991. Second, the scheme's eligibility rules provide a research design for examining principal retirement. In particular, principals wishing to take advantage of the scheme had to have accrued certain levels of experience or been of a certain age in 1991. We can therefore use a regression discontinuity design to take advantage of these rules: comparing outcomes at schools with a principal that narrowly qualified for the scheme and at schools with a principal that narrowly failed to qualify for the scheme. Third, the scheme took schools and parents almost completely by surprise: it was first proposed in April of 1991 and all of the retirements had occurred by September of 1991.

To see the potential of this experiment more clearly, consider a simplified version of the scheme in which eligibility is based on a single index and there is complete compliance. That is, suppose that in 1991, all schools with principals below age 55 kept their principal while all schools with principals above age 55 lost theirs. Suppose also that the schools that lost principals replaced them with a random draw from a pool of potential new principals. The effects of principal experience could then be identified via a comparison of next year's outcomes at control schools (which kept their experienced principal) and treatment schools (that replaced their experienced principal with an inexperienced one).

As with the school fixed effects estimates, this comparison will identify the combined effect of the difference in experience and the differences in observed and unobserved characteristics between the two groups. The quasi-experimental nature of this variation will however allow us to interpret these estimates as causal effects of principal experience under weaker assumptions than

were used in the school fixed effects analysis. Rather than rely on school fixed effects and student controls to capture school and student sorting, we will rely on the assumption that the scheme was unanticipated and that there would, in the absence of the scheme, have been no difference in the performance of schools led by principals that were narrowly eligible and narrowly ineligible for the scheme.

Conclusion

This paper provides one of the first sets of estimates of the relationship between school performance and school principal characteristics. The conventional wisdom is that principals exert an important influence on school performance but this view is based mainly on anecdotal evidence. We focus on three sets of characteristics: principals' education and pre-principal experiences; principal experience and principal participation in principal training programs, now popular in many school districts.

We find little evidence of any relationship between school performance and principal education and pre-principal characteristics, although we do find some evidence that experience as an assistant principal in their current school is associated with higher performance of schools led by inexperienced principals. We find mixed evidence in regard to principal training and professional development programs, although program rules are such that it is hard to isolate the effects of these programs. Our clearest finding is that schools perform better when they are led by experienced principals. The experience profile is especially steep over the first few years.

The finding of positive experience effects accords with common sense: workers performing most tasks will become more productive with experience at the task, especially when the task is as demanding as running a school. It does however have important policy implications. First, it alerts district administrators to the potential costs of having experienced principals leave their jobs or equivalently, informs them of the benefits associated with retaining experienced principals. Second, it alerts district administrators to the distributional consequences that follow from higher rates of principal

turnover in disadvantaged schools. Given the importance of these implications, and since our estimates are larger than those found in the related literature, we would like to be sure that they are not biased by the sorting of experienced principals to good schools and good students. In the analysis presented here we have taken a number of steps to ensure these biases are minimized. In ongoing work we seek to exploit a natural experiment to obtain quasi-experimental estimates of these experience effects.

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Data Appendix

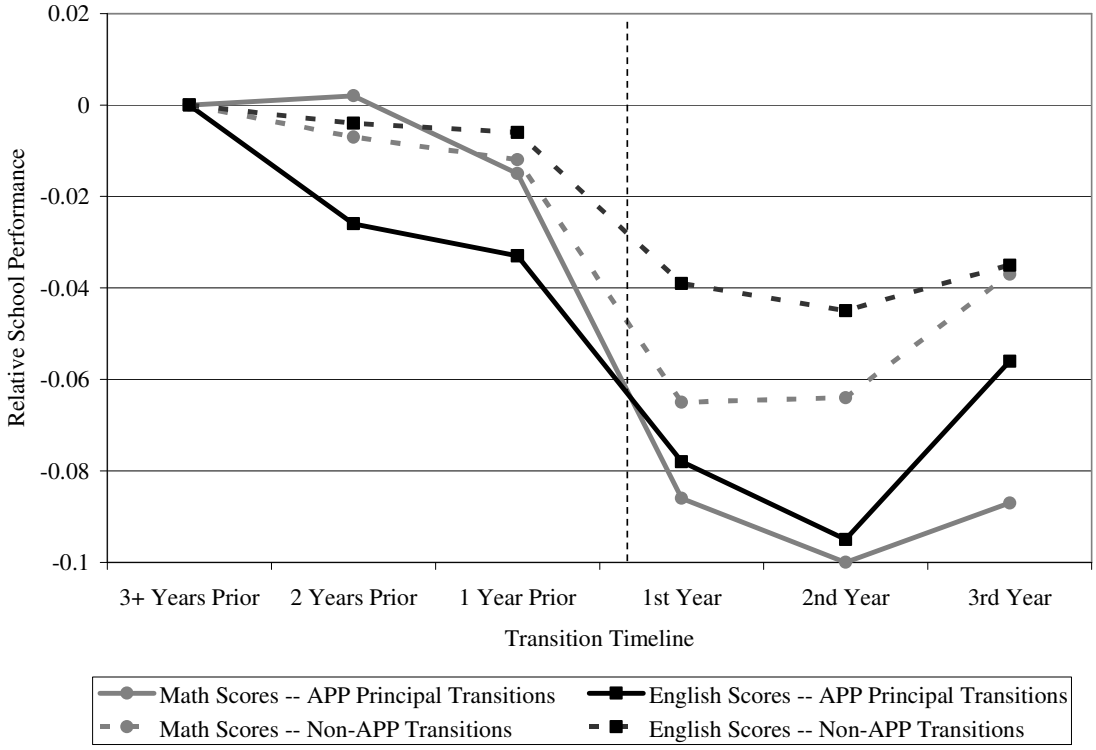
The data used in the paper come from several sources: personnel files on principals, personnel files on teachers, and student achievement and enrollment files. These data are formatted separately and then merged together by school and school year. Each employee in the NYC school system has a service history file, which traces the location and type of work they perform over time. These files are in spell format, e.g., one line in an individual's file might state that he/she worked as an assistant principal in a particular school from September 1, 1995 through June 30, 1998. We use data on the complete service history for every person that worked as a NYC principal between 1982 and 2007. Because these files contain full employment histories, the earliest spells date from the 1940s (when several of these principals were teachers in NYC) and extends through the school year 2006-2007, by which time many principals had left NYC or moved into a non-principal position (e.g., district administrator). We record these spell data to determine principals' activities in the fall and spring of every school year during their employment history. We then used these data to measure principal experience in teaching, as an assistant principal, and as a principal, both overall and within their current school. For individuals that retired before 1992, some of the employment information is truncated in 1982. For this reason, our descriptive statistics are limited to principals employed from 1992 onwards, but our information is complete for all principals working in the period for which we analyze school performance.

In addition to these service history files, we were provided with data on principals' tertiary education, including institutions from which degrees were received, and training programs the principal attended. These data are only available for the more recent period on which we focus our analysis. We use data on degree attainment to create variables for the selectivity of the institution from which the principal received their BA and MA degrees.

Student data contain information on demographic background, attendance, suspensions from school, test performance, eligibility for free lunch, special education and bilingual education. Teacher personnel files contain information on teacher characteristics (e.g., education, experience, certification),

employment history (from which we derive measures of turnover), and the timing and type of absences taken during the year. We focus on absences that are coded as "Self-treated Sickness" and "Personal Days," which are arguably under teachers' control. Other types of absences include jury duty, military service, funeral attendance, and medically certified illnesses. These data are described in greater detail in Kane, Rockoff and Staiger (2008) and Herrmann and Rockoff (2009).

Figure 1: School Performance During the Transition to New Principal



Note: This figure plots the expected change in student test score performance as a school transitions from a principal with 5 or more years of experience to a new principal. The estimates used to create the figure are those shown in Table 11 and an estimate (from the same regressions) of the impact of a principal having 5 or more years of experience (0.042 for math scores and 0.026 for English scores) relative to no experience. We estimate transition effects separately for schools that transitioned to the new principal from the Aspiring Principals Program (APP) and those that transitioned to a principal trained through a more traditional route during the school years 2004-05 through 2006-07.

Table 1: Principal Characteristics in New York City, 1987-2007

	All Principals						New Principals			
Year	Total Employed	<3 Years of Principal Experience	3-7 Years of Principal Experience	Was AP in School	Female	Non-white	Number Hired	Was AP in School	Female	Non-White
1987	838	.	.	.	0.33	0.28	90	0.09	0.33	0.46
1992	922	0.51	0.20	0.15	0.44	0.33	202	0.27	0.55	0.43
1997	1036	0.41	0.28	0.17	0.51	0.40	152	0.22	0.56	0.43
2002	1185	53.8%	19.2%	19.2%	62.7%	41.5%	162	24.1%	68.5%	41.4%
2003	1213	55.0%	23.4%	19.8%	63.9%	43.3%	217	24.4%	64.8%	41.0%
2004	1256	56.7%	25.4%	22.8%	66.8%	45.8%	239	31.4%	70.7%	47.3%
2005	1362	64.8%	19.8%	22.2%	68.1%	47.5%	260	24.6%	68.5%	48.5%
2006	1420	65.0%	18.7%	21.8%	67.9%	48.3%	153	22.9%	67.3%	52.3%
2007	1452	61.7%	19.6%	21.4%	67.6%	49.4%	123	26.8%	71.5%	43.1%

Notes: Statistics based on authors' calculations. There are no entries for principal or AP experience of all principals in 1987 because some data on work history for existing principals are missing before 1992. Demographic information is missing for some principals and the percent female and non-white is conditional on having non-missing data.

Table 2: Training and Professional Development Programs, 2002-2007

	Pre-Principal Training				Professional Development
	Aspiring Principals	New Leaders for New Schools	Tom-orrows Principals	Bank St Academy	Cahn Fellows
2002	0%	0%	0%	0.08%	0%
2003	0%	0%	0%	0.08%	0%
2004	0%	0%	0%	0.16%	0.72%
2005	4.77%	0.73%	0%	0.22%	1.91%
2006	8.03%	1.27%	0.28%	0.28%	3.10%
2007	11.43%	1.72%	0.55%	0.28%	3.86%

Notes: Cells describe percentage of principals in each academic year that had, at some time, participated in each of these training programs

Table 3: School Characteristics by Principal Experience

Years of Principal Experience	Number of Principals	% Receiving Free Lunch	% Receiving Reduced-price Lunch	% English Language Learners	% Non-White	Average Prior English Score	Average Prior Math Score
0	1301	0.74	0.09	0.11	0.90	0.02	0.01
1	1175	0.74	0.09	0.11	0.90	0.04	0.04
2	1061	0.74	0.09	0.11	0.89	0.06	0.07
3	814	0.74	0.09	0.11	0.89	0.09	0.11
4	644	0.73	0.10	0.10	0.89	0.09	0.11
5-6	901	0.72	0.11	0.10	0.89	0.09	0.12
7-9	916	0.74	0.08	0.10	0.88	0.14	0.16
10+	999	0.76	0.08	0.10	0.86	0.14	0.18

Notes: Table based on 7811 principal-year observations for 2076 principals in 1064 elementary and middle schools over the school years 1998-99 to 2006-07. Prior English and math scores refer to prior test scores of students tested in the current year and are expressed as z-scores, with a mean of zero and standard deviation of one within grade-level and year. There are fewer principal-year observations for these variables (6941 for math, 6937 for English) because prior scores are not available in some years and for some schools. Also, schools serving only special education students are omitted, since many of these students are not tested, hence this population's average score is above zero.

Table 4: School Characteristics and Principal Transitions across Schools

	New school				
Old School	N/A	SES-1	SES-2	SES-3	SES-4
SES-1 (29.79%)	81.6%	10.8%	4.4%	2.2%	1.0%
SES-2 (26.41%)	93.2%	0.7%	3.6%	1.4%	1.1%
SES-3 (22.18%)	92.8%	0.9%	2.6%	1.3%	2.6%
SES-4 (21.62%)	92.6%	0.9%	1.3%	1.3%	3.9%
Overall	88.5%	4.2%	3.2%	1.9%	2.3%

Notes: The table describes the characteristics of the schools that principals leave and the schools to which that they transfer (if a transfer is made). School SES is defined in terms of quartiles of the prior math score distribution, where prior reading and math scores refer to prior test score of students tested in the current year and are expressed as z-scores, with a mean of zero and standard deviation of one within grade-level and year. The data cover the school years 1998-99 to 2006-07. There are 1,246 principal separations involving 1180 principals in 784 elementary and middle schools.

Table 5: Principal Experience and Transitions Within Schools

	New Principal Expereince			
Prior Principal Experience	None (First Year)	One to Three Years Exp.	Four to Six Years Exp.	Seven or More Years Experience
All Experience Levels	84.0%	10.1%	3.3%	2.6%
One to Three Years (43.03%)	83.5%	12.1%	2.1%	2.3%
Four to Six Years (21.51%)	83.5%	10.2%	3.0%	3.4%
Seven or More Years (35.46%)	84.8%	7.7%	4.9%	2.6%

Notes: The table describes experience levels among outgoing and incoming principals when a principal transition occurs within a school. The data cover the school years 1998-99 to 2006-07 onwards. There are 1097 such transitions involving 745 principals in 1043 elementary and middle schools.

Table 6: Student Achievement and Principal Credentials

	Math Test Scores		English Test Scores	
Selectivity of BA School (Median SAT)	0.001	-0.003	0.003	-0.002
	(0.003)	(0.002)	(0.003)	(0.002)
Selectivity of MA School (Median SAT)	-0.002	-0.000	-0.004	-0.002
	(0.003)	(0.003)	(0.003)	(0.002)
Aspiring Principals Program Graduate	-0.062*	-0.036+	-0.064*	-0.035*
	(0.022)	(0.019)	(0.018)	(0.013)
Cahn Fellow (Pre-selection)	0.110*	0.003	0.109*	0.016
	(0.028)	(0.024)	(0.026)	(0.015)
Cahn Fellow (Post-selection)	0.189*	0.038	0.174*	0.039+
	(0.034)	(0.029)	(0.035)	(0.020)
Years as Assistant Principal (current school)	0.005*	0.000	0.004*	-0.001
	(0.002)	(0.001)	(0.002)	(0.001)
Years as Teacher (current school)	0.002+	-0.000	0.002*	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
1 Year as Principal	0.009+	0.007*	0.002	0.001
	(0.005)	(0.004)	(0.004)	(0.003)
2 Years as Principal	0.027*	0.023*	0.012*	0.009*
	(0.006)	(0.005)	(0.005)	(0.004)
3 Years as Principal	0.038*	0.035*	0.017*	0.013*
	(0.007)	(0.006)	(0.007)	(0.005)
4 Years as Principal	0.039*	0.037*	0.025*	0.020*
	(0.008)	(0.006)	(0.008)	(0.006)
5 or More Years as Principal	0.061*	0.039*	0.048*	0.026*
	(0.009)	(0.006)	(0.009)	(0.005)
Joint Test of Principal Experience (p-value)	0.00	0.00	0.000	0.000
Zip Code Fixed Effects	Y		Y	
School Fixed Effects		Y		Y
Observations	3,690,658	3,690,658	3,367,302	3,367,302
Adjusted R2	0.33	0.34	0.32	0.34

Note: The unit of observation is a student-year. All regressions include year-grade fixed effects, controls for students' grade level, ethnicity, gender, grade repetition, and participation in free lunch, English language learner, and special education programs, and school-year cell averages of the student level controls and class size. Coefficients on individual student characteristics are allowed to differ by grade level. Standard errors are clustered by school.

Table 7: Impact of Student Test Controls in Middle School Sample

	Math Test Scores			English Test Scores		
	Elementary	Middle	Middle	Elementary	Middle	Middle
Selectivity of BA School (Median SAT)	-0.001	-0.003	-0.001	-0.000	-0.003	0.001
	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Selectivity of MA School (Median SAT)	-0.000	-0.001	-0.000	-0.001	-0.002	-0.000
	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)
Aspiring Principals Program Graduate	-0.019	-0.054*	-0.027	-0.011	-0.050*	-0.008
	(0.022)	(0.025)	(0.022)	(0.018)	(0.019)	(0.017)
Cahn Fellow (Pre-selection)	0.011	-0.003	0.016	0.001	0.030	0.049
	(0.030)	(0.035)	(0.045)	(0.020)	(0.019)	(0.034)
Cahn Fellow (Post-selection)	0.033	0.050	0.060	0.033	0.031	0.044
	(0.029)	(0.056)	(0.065)	(0.027)	(0.027)	(0.039)
Years as Assistant Principal (current schoc	0.003+	-0.002	-0.002	0.004*	-0.004*	-0.003*
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
Years as Teacher (current school)	-0.000	-0.000	0.001	0.000	-0.001	0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
1 Year as Principal	0.011*	0.003	0.002	0.006	-0.004	-0.004
	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)	(0.006)
2 Years as Principal	0.029*	0.017*	0.018+	0.010*	0.007	0.009
	(0.006)	(0.008)	(0.009)	(0.005)	(0.006)	(0.007)
3 Years as Principal	0.035*	0.036*	0.032*	0.009	0.019*	0.014
	(0.007)	(0.009)	(0.011)	(0.006)	(0.007)	(0.009)
4 Years as Principal	0.041*	0.033*	0.032*	0.013*	0.032*	0.030*
	(0.008)	(0.009)	(0.011)	(0.007)	(0.009)	(0.010)
5 or More Years as Principal	0.050*	0.027*	0.022*	0.033*	0.019*	0.015
	(0.008)	(0.010)	(0.011)	(0.006)	(0.009)	(0.010)
Joint Test of Principal Experience (p-value	0.00	0.00	0.04	0.000	0.010	0.050
Student Test Controls			Y			Y
Observations	2,135,113	1,555,545	1,555,545	2,008,796	1,358,506	1,358,506
Adjusted R2	0.33	0.37	0.48	0.32	0.37	0.49

Notes: All specifications include the controls listed in the notes to Table 6. Third and sixth columns also include controls for student's prior (i.e., elementary school) test score.

Table 8: Student Behavior and Principal Credentials

	Absences		Suspensions/100	
Selectivity of BA School (Median SAT)	0.047	0.016	0.001	0.001
	(0.030)	(0.028)	(0.001)	(0.001)
Selectivity of MA School (Median SAT)	0.012	-0.005	0.000	0.000
	(0.032)	(0.028)	(0.001)	(0.001)
Aspiring Principals Program Graduate	0.116	0.095	0.026*	0.021*
	(0.186)	(0.174)	(0.007)	(0.008)
Cahn Fellow (Pre-selection)	-0.744*	-0.058	-0.005	-0.007
	(0.210)	(0.151)	(0.004)	(0.008)
Cahn Fellow (Post-selection)	-0.966*	-0.287	-0.002	-0.003
	(0.290)	(0.200)	(0.008)	(0.011)
Years as Assistant Principal (current school)	-0.018	-0.003	-0.001*	-0.001+
	(0.020)	(0.018)	(0.000)	(0.000)
Years as Teacher (current school)	-0.009	-0.003	-0.000*	-0.001+
	(0.011)	(0.009)	(0.000)	(0.000)
1 Year as Principal	-0.093	-0.107*	0.000	-0.001
	(0.061)	(0.052)	(0.002)	(0.002)
2 Years as Principal	-0.185*	-0.183*	-0.000	-0.002
	(0.072)	(0.062)	(0.002)	(0.002)
3 Years as Principal	-0.143	-0.166*	-0.005*	-0.007*
	(0.090)	(0.073)	(0.002)	(0.002)
4 Years as Principal	-0.291*	-0.264*	-0.004	-0.005+
	(0.094)	(0.078)	(0.002)	(0.003)
5 or More Years as Principal	-0.411*	-0.240*	-0.005*	-0.004*
	(0.098)	(0.069)	(0.002)	(0.002)
Joint Test of Principal Experience (p-value)	0.000	0.010	0.020	0.050
Zip Code Fixed Effects	Y		Y	
School Fixed Effects		Y		Y
Observations	3,851,268	3,851,268	3,851,268	3,851,268
Adjusted R2	0.13	0.15	0.03	0.04

Note: The unit of observation is a student-year. All regressions include year-grade fixed effects, controls for students' grade level, ethnicity, gender, grade repetition, and participation in free lunch, English language learner, and special education programs, and school-year cell averages of the student level controls and class size. Coefficients on individual student characteristics are allowed to differ by grade level. Standard errors are clustered by school.

Table 9: Teacher Outcomes and Principal Credentials

	Total "Voluntary" Absences	Does Not Return to NYC Next Year	Does Not Return to School Next Year
Selectivity of BA School (Median SAT)	-0.025	0.001	-0.001
	(0.017)	(0.001)	(0.002)
Selectivity of MA School (Median SAT)	0.022	-0.001	0.000
	(0.018)	(0.001)	(0.002)
Aspiring Principals Academy	-0.132	0.007	0.017+
	(0.102)	(0.005)	(0.010)
Cahn Fellow (Pre-selection)	-0.142	0.007	-0.004
	(0.157)	(0.006)	(0.009)
Cahn Fellow (Post-selection)	-0.234	-0.000	-0.016
	(0.207)	(0.008)	(0.011)
Years as Assistant Principal (current school)	0.033*	-0.000	-0.001
	(0.009)	(0.000)	(0.001)
Years as Teacher (current school)	-0.001	0.000	-0.000
	(0.006)	(0.000)	(0.000)
1 Year as Principal	0.004	-0.003	-0.003
	(0.032)	(0.002)	(0.003)
2 Years as Principal	0.011	-0.001	-0.000
	(0.035)	(0.002)	(0.004)
3 Years as Principal	0.003	-0.006*	-0.009*
	(0.041)	(0.002)	(0.004)
4 Years as Principal	-0.056	-0.006*	-0.011*
	(0.044)	(0.003)	(0.004)
5 or More Years as Principal	-0.023	-0.004+	-0.010*
	(0.044)	(0.002)	(0.004)
Joint Test of Principal Experience (p-value)	0.63	0.07	0.01
Observations	425,872	426,517	426,517
Adjusted R2	0.06	0.01	0.03

Note: Voluntary absences include self-treated illness and personal days. See Data Appendix for more details. All specifications include covariates listed in the notes to Table 6.

Table 10: Student Outcomes and Prior Experience as Assistant Principal or Teacher in Current School

	Math Test Scores		English Test Scores		Student Absences		Suspensions Per 100 Students	
First 2 Years as Principal:								
Ever Assistant Principal in Current School	0.024*		0.026*		-0.149		-0.007*	
	(0.010)		(0.008)		(0.101)		(0.003)	
Years as Assistant Principal in Current School		0.003*		0.001		-0.012		-0.001
		(0.001)		(0.001)		(0.018)		(0.001)
Ever Teacher in Current School	-0.012		-0.017+		-0.109		-0.009*	
	(0.013)		(0.010)		(0.132)		(0.005)	
Years as Teacher in Current School		-0.000		-0.001		-0.008		-0.001*
		(0.001)		(0.001)		(0.010)		(0.000)
Years 3+ as Principal:								
Ever Assistant Principal in Current School	-0.015		-0.010		-0.016		-0.001	
	(0.011)		(0.008)		(0.119)		(0.003)	
Years as Assistant Principal in Current School		-0.002		-0.002		-0.001		-0.001
		(0.001)		(0.002)		(0.021)		(0.000)
Ever Teacher in Current School	0.002		-0.002		-0.100		-0.005	
	(0.014)		(0.010)		(0.152)		(0.004)	
Years as Teacher in Current School		-0.000		0.000		-0.001		-0.000
		(0.001)		(0.001)		(0.011)		(0.000)
Observations	3,690,658	3,690,658	3,367,302	3,367,302	3,851,268	3,851,268	3,851,268	3,851,268
Adjusted R2	0.34	0.34	0.34	0.34	0.15	0.15	0.04	0.04

Note: The unit of observation is a student-year. All regressions include school fixed effects, year-grade fixed effects, controls for students' grade level, ethnicity, gender, grade repetition, and participation in free lunch, English language learner, and special education programs, and school-year cell averages of the student level controls and class size. Coefficients on individual student characteristics are allowed to differ by grade level. Other time-varying and time-invariant principal characteristics shown in Table 1 (other than AP or teacher experience) are also included as covariates.

Table 11: Student Achievement and Aspiring Principals Program Transitions

	Math Test Scores	English Test Scores	Student Absences	Suspensions Per 100 Students
Aspiring Principals Program (APP)				
2 Years Prior to Entrance	0.002	-0.026*	0.069	0.003
	(0.014)	(0.013)	(0.192)	(0.005)
1 Year Prior to Entrance	-0.015	-0.033*	-0.042	0.001
	(0.016)	(0.016)	(0.213)	(0.006)
1st Year as Principal	-0.044*	-0.052*	0.155	0.025*
	(0.019)	(0.017)	(0.207)	(0.009)
2nd Year as Principal	-0.058*	-0.069*	-0.079	0.028*
	(0.029)	(0.019)	(0.248)	(0.011)
3rd Year as Principal	-0.045	-0.030	-0.227	0.037*
	(0.035)	(0.022)	(0.356)	(0.016)
Transition to Non-APP Principal				
2 Years Prior to Entrance	-0.007	-0.004	0.008	0.002
	(0.006)	(0.005)	(0.081)	(0.003)
1 Year Prior to Entrance	-0.012	-0.006	0.104	0.006*
	(0.008)	(0.007)	(0.094)	(0.003)
1st Year as Principal	-0.023+	-0.013	-0.200	0.013*
	(0.013)	(0.010)	(0.134)	(0.006)
2nd Year as Principal	-0.031+	-0.022+	-0.041	0.015*
	(0.016)	(0.013)	(0.153)	(0.007)
3rd Year as Principal	-0.015	-0.017	-0.238	0.012
	(0.020)	(0.016)	(0.173)	(0.009)
School Fixed Effects	Y	Y	Y	Y
Observations	3,690,658	3,367,302	3,851,268	3,851,268
Adjusted R2	0.34	0.34	0.15	0.04

Note: The unit of observation is a student-year. In addition to all principal credentials shown in Table 6, all regressions include year-grade fixed effects, controls for students' grade level, ethnicity, gender, grade repetition, and participation in free lunch, English language learner, and special education programs, and school-year cell averages of the student level controls and class size. Coefficients on individual student characteristics are allowed to differ by grade level. Standard errors are clustered by school.

Table 12: Student Outcomes and Time-Varying Principal Credentials

	Math Test Scores	English Test Scores	Absences	Suspensions /100
Cahn Fellow (Post-selection)	0.028	0.024	-0.325+	0.009
	(0.017)	(0.018)	(0.170)	(0.009)
1 Year as Principal	0.002	-0.001	-0.070	0.002
	(0.004)	(0.004)	(0.050)	(0.002)
2 Years as Principal	0.014*	0.003	-0.116	0.004
	(0.007)	(0.006)	(0.072)	(0.002)
3 Years as Principal	0.022*	0.001	-0.130	0.001
	(0.009)	(0.008)	(0.096)	(0.003)
4 Years as Principal	0.029*	0.011	-0.257*	0.002
	(0.012)	(0.011)	(0.118)	(0.004)
5 or More Years as Principal	0.030+	0.014	-0.244	-0.001
	(0.016)	(0.014)	(0.149)	(0.004)
Joint Test of Principal Experience (p-value)	0.05	0.250	0.260	0.100
Principal-School Fixed Effects	Y	Y	Y	Y
Observations	3,690,658	3,367,302	3,851,268	3,851,268
Adjusted R2	0.35	0.34	0.15	0.05

Note: The unit of observation is a student-year. All regressions include year-grade fixed effects, controls for students' grade level, ethnicity, gender, grade repetition, and participation in free lunch, English language learner, and special education programs, and school-year cell averages of the student level controls and class size. Coefficients on individual student characteristics are allowed to differ by grade level. Standard errors are clustered by school.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