IESP

# The New York City Aspiring Principals Program

## A School-Level Evaluation

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## I. Introduction and Overview

In 2003, the New York City Department of Education (NYCDOE)—the largest public school district in the nation—embarked on a unique experiment to increase its pool of qualified school administrators. Through the creation of the New York City Leadership Academy (the Leadership Academy), the district asserted significantly greater responsibility for training and developing its own school leaders (Olson, 2007).

Like many cities, New York suffers from a persistent shortage of principals, due to high turnover, a surge in retirements, and the rapid creation of new schools (Papa, Lankford, and Wyckoff, 2002; Lankford, O'Connell, and Wyckoff, 2003). The Leadership Academy—an independent, not-for-profit organization—represents the centerpiece of New York City's attempts to expand its principal labor pool while at the same time increasing the autonomy and day-to-day responsibilities of its school leaders. Its programs are together aimed at recruiting, preparing, and supporting the professional development of aspiring and sitting principals. In particular, the Leadership Academy seeks to prepare principals for schools marked by high student poverty, low achievement and frequent staff turnover—schools in which principal vacancies had been historically hard to fill. Today, the Leadership Academy works with hundreds of principals annually and its Aspiring Principals Program graduates are currently responsible for 15 percent of the city's schools.[1]

Aspiring Principals (APP), the Leadership Academy's pre-service principal preparation program, is a 14-month intensive program involving three components.[2] The first is the *summer intensive*, where participants work on simulated school projects intended to mimic the realities of an actual principalship. The second component, the *residency*, involves a ten-month "apprenticeship"

[1] http://www.nycleadershipacademy.org/overview/overview [last accessed June 2, 2009].
[2] http://www.nycleadershipacademy.org/aspiringprincipals/app_overview [last accessed: May 12, 2009].

with an experienced principal, along with bi-weekly leadership development seminars. Finally, the *planning summer* allows participants an opportunity to transition to their school leadership position.

This report represents the first systematic comparison of student outcomes in schools led by APP graduates after three years to those in comparable schools led by other new principals. We provide both a straightforward comparison of average achievement in these two groups of schools, and in efforts to isolate a potential program effect, we conduct a formal regression analysis that accounts for pre-existing differences in student performance and characteristics. We also report key differences between the school leaders themselves and the schools in which they were placed. All principals in this study were installed in 2004-05 or 2005-06, remained in the same school for three or more consecutive years, and led their school through the 2007-08 school year.

We find that the first two cohorts of APP principals were placed in schools that were demographically, geographically, and academically distinct from comparison schools led by other new principals. In keeping with the Leadership Academy's mission of placing graduates in the hardest-to-staff schools, APP principals were more likely to be placed in schools that were low-performing, relative to both the citywide average and to schools receiving a new principal at the same time. Moreover, the average APP elementary/middle school was trending downward in both English Language Arts (ELA) and mathematics scores, relative to the citywide average, before APP principals took the helm.

During the period of this study, New York City schools as a whole improved their average annual state assessment scores in both ELA and mathematics, and students in schools that experienced a leadership transition during this time experienced gains as well. However, controlling for pre-existing differences in student demographics and achievement, we find that APP principals bettered their comparison group counterparts in ELA performance, trending upward apace with

overall city-wide gains.[3] Whereas comparison schools, while also posting gains, fell further behind the rest of the city in their third and fourth years, APP schools remained stable, and by the third year the difference in these schools' trajectories becomes statistically significant. In mathematics, both groups' scores improved over time, although comparison principals' schools trended slightly better in the years following the arrival of their new principal, with differences that are small and most often not statistically significant. At the high school level, we find minor and inconclusive differences in achievement between APP and comparison schools.

**In brief, our study finds:**

- APP and comparison principals have different characteristics
    - APP principals are younger and more likely to be black than those in the comparison group. The average age of APP principals in the study was 40.9, as compared with 44.4 for comparison principals. Forty-one percent of APP principals were black versus 29 percent of comparison principals.
    - Both APP and comparison principals had substantial experience in the classroom. However, APP principals had three fewer years of teaching experience on average than comparison principals, at 7.3 versus 10.3 years.
    - APP principals were unlikely to have served as an assistant principal. Seventy-eight percent of APP principals had no prior experience as an assistant principal, while most comparison principals (82 percent) had some experience in this position. Comparison principals had also worked at their respective schools longer, in positions other than principal.
- APP and comparison principals were placed in schools with different demographic profiles

[3]As explained in Section II, we refer to "APP schools" as schools that were eventually led by an APP principal in our study. "Comparison schools" are schools that were eventually led by a non-APP novice principal.

- In elementary and secondary schools, APP principals were more likely to be located in the Bronx (32 percent versus 18 percent of comparison principals), while comparison principals were more likely to be found in Brooklyn and Queens. APP principals in high schools were more likely to be working at schools in Manhattan than comparison high school principals.
- APP schools enrolled fewer Asian and white students than comparison schools, and had a significantly greater share of black students (43 percent in APP schools versus 31 percent in comparison schools). On average, APP schools were smaller than comparison schools, at both the elementary/middle and high school levels.

- APP and comparison principals were placed in schools with different performance levels and histories
  - Schools in which APP principals were placed exhibited lower initial levels of performance than comparison principals' schools, an achievement gap that *preceded* the arrival of these new principals. The average APP elementary and middle school student performed substantially below their citywide grade level average in ELA and mathematics in the years before their new principal, while students in comparison schools scored approximately at citywide grade-level average. These pre-existing differences are evident regardless of whether one compares scale scores, proficiency rates, or standardized scores.[4]
  - Elementary and middle schools in which APP principals were placed were generally on a sharp downward trend in mathematics and ELA—relative to the citywide average—in the years preceding the new principal. This was especially evident for

[4] For most of our analysis we use *average standardized scores* as our measure of student achievement. These scores indicate how far the average student in a school scored from his/her citywide grade level average, in standard deviation units. As we explain in Section V, these scores are the best suited to making comparisons across tests, grades, and years.

the 2005 cohort of APP schools. Comparison schools, by contrast, experienced relatively stable performance in these subjects prior to their new principal.

- In the initial years of their leadership, elementary and middle school APP principals had comparable or better growth trends than comparison principals
    - Controlling for pre-existing differences in student demographics and achievement, APP principals bettered their comparison group counterparts in ELA, trending upward apace with overall city-wide gains. Whereas comparison schools fell further behind the rest of the city in their third and fourth years, APP schools remained stable, and by the third year the difference in these schools' trajectories is statistically significant. In mathematics, both APP and comparison schools scores improved over time, although APP schools trended slightly worse following the arrival of their new principal. These differences, however, are small and not consistently statistically significant.
- School performance differences at the high school level are small and mostly inconclusive
    - APP and comparison high schools differed in their average state Regents' Exam scores, proportions of students taking Regents exams, and graduation rates, both before and after the arrival of their new principal. The significance of these differences, however, is inconclusive, given the small sample of high school principals in the study.

The remainder of this report is organized as follows. Section II describes how APP and comparison principals were selected for inclusion in the study. Section III contrasts the average characteristics of APP principals with those of other novice principals selected as our comparison group. Sections IV and V use administrative data from NYCDOE to provide a baseline comparison

of students and schools served by APP and comparison principals. Section VI is a descriptive analysis of average student achievement in APP and comparison schools, both in the principals' initial year and in years before and after the arrival of the new principal. Finally, sections VII and VIII provide a formal regression analysis of student achievement in APP and comparison schools.

## II. Description of the Data and Sample

The primary goal of this report is to compare schools led by Aspiring Principals Program (APP) graduates to comparable schools led by non-APP principals. In this section, we describe how principals and schools were selected for this analysis. The first step required the identification of APP and non-APP principals with comparable years of experience leading a school (roughly 2.8 – 4.6 years). The second involved further limiting this group to those who led one school for a sufficient time to be meaningfully evaluated.[5] The final step involved matching principals to student outcomes in administrative data from the NYCDOE.

For most of the schools in our analysis, we have measured outcomes for years *prior to* the new principal's installation and years *following* his or her arrival. Having both of these measures allows for a "pre" and "post" comparison of outcomes within the same schools. Throughout this report, we refer to schools eventually led by an APP principal as "APP schools." "Comparison schools" are schools eventually led by a comparison principal. Both APP and comparison schools are observed *before* and *after* the arrival of their new principal. Only "post" outcome measures are available for *new* schools. While we include new schools in our descriptive analyses, we are unable to include these schools in "pre" and "post" comparisons.[6]

[5]Our requirement that principals remain in one school for three consecutive years is based on the notion that it takes time to see evidence of school improvement in student test scores. Scholars of school improvement (e.g. Fullan and Stiegelbauer, 1991) suggest three years as the minimum amount of time needed to see such results.
[6] In future work, we hope to use student-level data to provide a baseline level of achievement for principals leading new schools.

## Selection of APP and comparison principals

For this study, we restricted our attention to graduates of the *first two* cohorts of the Aspiring Principals Program (2004 and 2005) who became principals in 2004-05 and 2005-06, remained with the same school for three or more consecutive years, and continued as principals in 2007-08. Comparison principals were also required to meet these criteria to be included. Because of these restrictions, not all principals who began service in these years are represented in this analysis. Of the 147 graduates in the 2004 and 2005 APP cohorts, 88 percent (n=130) were placed as a school principal at the time of our study. Sixty percent (n=88) met our strict inclusion criteria.[7] The other 40 percent (n=59) are excluded for a variety of reasons, as summarized in Table 1.

***Table 1: Core sample of APP graduates***

| | N | % |
|---|---|---|
| Number of APP graduates, 2005 and 2006 cohorts | 147 | 100.0 |
| APP graduates included in the analysis | 86 | 58.5 |
| Excluded APP graduates: | | |
| Placed as principal: | | |
| Currently principal but did not meet 3-year tenure requirement (e.g. switched schools) | 15 | 10.2 |
| Met 3-year tenure requirement but not currently principal (e.g. promoted) | 2 | 1.4 |
| Served as principal in District 75 school | 2 | 1.4 |
| Served as principal and transferred to lateral DOE position | 9 | 6.1 |
| Served as principal and then exited DOE | 6 | 4.1 |
| Not placed as principals: | | |
| Served as interim acting principal and/or assistant principal only | 13 | 8.8 |
| Placed in other positions (e.g. program director, central administration, or teacher) | 9 | 6.1 |
| Served in other position and/or exited DOE | 4 | 2.7 |
| Other | 1 | 0.7 |
| Total excluded | 61 | 41.5 |

Source: New York City Leadership Academy.

As shown in Table 1, 13 percent of the 2004 and 2005 APP graduates were initially placed as principals but were later promoted, transferred to a lateral position in the DOE, or left the NYC public school system.[8] Another 10.2 percent switched schools during the study period, in some cases because their initial placement was to phase-out a chronically low-performing school. Finally, at the

[7] Further, 2 of these 88 were placed in District 75 schools, which exclusively serve special education students. These principals are excluded from our analysis. This leaves 86 eligible APP principals.

[8] We do not have comparable principal mobility numbers for non-APP principals. Thus it is difficult to say whether the 60 percent of APP principals who met our strict inclusion criteria is high, low, or about the same as for non-APP principals.

time of study, 18.3 percent had not become principals in the NYC public schools, but had accepted other positions within or outside NYC (including assistant principal, central administration, and teaching positions). Of these, about a fifth served as an interim principal before assuming permanent positions as assistant principals.

For our comparison group, we drew from a list of all active NYC principals in 2007-08 and identified those who were new principals in 2004-05 or 2005-06, and had remained in the same school for three or more years. 371 non-APP principals met these criteria. Of these, 334 led schools with grade configurations comparable with those led by APP principals. We refer to the 86 eligible APP and 334 eligible comparison principals as our "combined sample" in Panel A of Table 2.

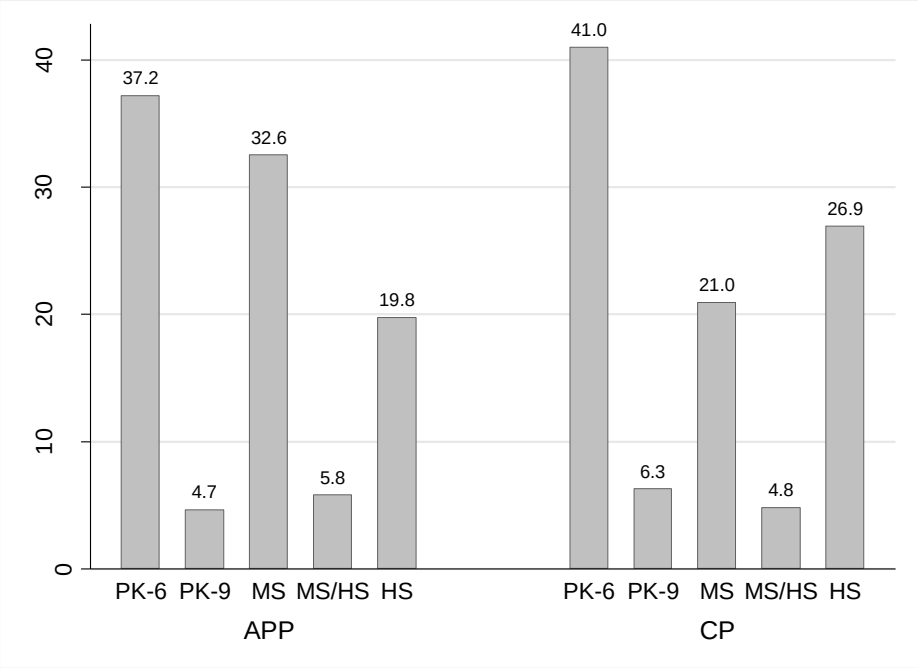
***Table 2: Samples of APP and comparison principals and schools***

| | APP Principals | Comparison Principals | Total |
|---|---|---|---|
| A. Principal data | | | |
| Combined sample | 86 | 334 | 420 |
| Elementary/middle school sample | 69 | 244 | 313 |
| High school sample | 22 | 106 | 128 |
| B. Principals matchable to schools | | | |
| Elementary/middle school sample | 69 | 230 | 299 |
| High school sample | 22 | 105 | 127 |

The full combined sample of principals is used in Section III to provide a descriptive contrast of APP and comparison principals.[9] However, for our analysis of *schools* in Sections IV - VIII, we split principals into two groups: those in schools serving elementary and middle grades and those serving high school students. Panel A of Table 2 shows the counts of principals in each group, while Figure 1 shows the distribution of principals across five school configurations: elementary (PK-6), elementary / middle school combination (PK-9), middle school (MS), middle school / high school combination (MS/HS), and high school (HS).

[9] While comparisons by level add little beyond comparisons of APP and comparison principals in the combined sample, we do provide separate descriptive statistics by level in Appendix Table 1.

*Figure 1: Distribution of APP and comparison principals by school level*




Notes: combined sample of principals, N=420 (86 APP and 334 CP).

APP and comparison principals were similarly distributed across school configurations, although APP principals were more likely to be working in middle schools than comparison principals (32.6 percent versus 21.0 percent), and less likely to be working in high schools (19.8 percent versus 26.9 percent). Because combination middle / high schools fall into both subsamples, these schools are included in *both* analyses.

## Matching to school-level data

In order to compare school outcomes, it was necessary to match the principals identified in Panel A of Table 2 to administrative data from the NYCDOE. Fifteen of 334 comparison principals were not successfully matched to school-level data while 100 percent of APP principals were.[10] After

[10] The unmatched schools were coded as serving the middle school grades (3 level MS and 11 MS/HS), but in practice had no data available for middle school students. This may simply be due to miscodes in the school reports.

matching we are left with 69 APP and 230 comparison schools in the elementary / middle school sample, and 22 APP and 105 comparison principals in the high school sample (Panel B of Table 2).[11]

Another practical limitation on our data is the number of years for which school results are available. For example, principals that began work in 2005-06 have at most three years of results under their leadership, while those who began in 2004-05 have up to four.[12] Our elementary / middle school data series begins in 2002-03, so for some cases we observe schools up to three years *before* the arrival of their new principal (for those beginning in 2005-06), while for others we observe up to two years prior (for those beginning in 2004-05). For high schools, our data series begins in 2003-04, so we have at most two years of data prior to the installation of a new principal. New schools have no observable data prior to the tenure of the founding principal. Details on data availability for schools in each principal cohort are provided in Appendix Table 2.

## III. Characteristics of APP and Comparison Principals

Table 3 provides the average characteristics of APP and comparison principals in our combined sample.[13] We observe several statistically significant differences in the demographics of APP and comparison principals. For example, APP principals were younger and more likely to be black than those in the comparison group. As seen in Table 3, 40.7 percent of APP principals were black versus 29.3 percent of comparison principals. APP principals were somewhat less likely to be Hispanic (12.8 percent versus 17.4 percent) or white (44.2 percent versus 49.1 percent) than

[11] Again, the sum of the two APP subsamples (69 + 22 = 91) exceeds our total number of APP principals (86) because middle school / high school combination principals are included in both subsamples.
[12] In some cases, principals took leadership of a school in the middle of the school year. We coded those principals who joined a school in a given school year as present for the entire year.
[13] A comparison of principals by school level adds little beyond the information provided by the combined sample. We do, however, provide these statistics in Appendix Table 1. As this table shows, elementary / middle school principals (both APP and comparison) were less likely to be male than high school principals. APP high school principals were less likely to be white than APP elementary / middle principals (38.1 percent versus 48.5 percent). Comparison principals in the high schools were less experienced as teachers and assistant principals than their elementary/middle school counterparts, while APP principals in the high schools tended to have *more* prior experience than their primary school counterparts.

comparison principals. (Neither of these differences is statistically significant). A similar proportion of principals (31 percent) in both groups are male.

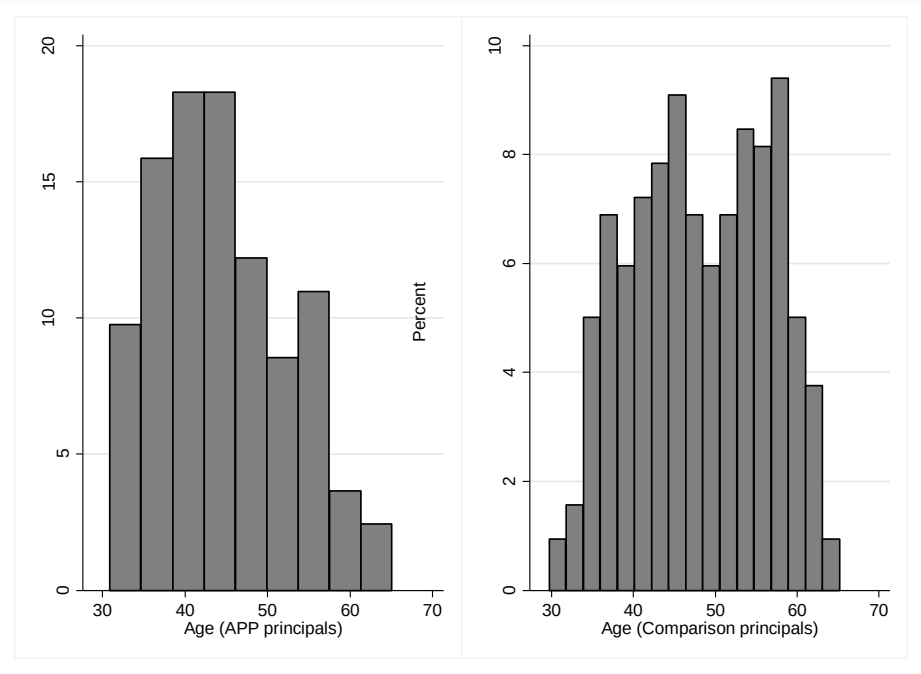
***Table 3: Mean characteristics of APP and comparison principals, all levels, 2007-08***

| | Mean | | | | SD | |
|---|---|---|---|---|---|---|
| | APP | Comparison | *p* | | APP | Comparison |
| Percent male | 31.4 | 31.1 | 0.963 | | - | - |
| Percent white | 44.2 | 49.1 | 0.416 | | - | - |
| Percent black | 40.7 | 29.3 | 0.044 | ** | - | - |
| Percent Hispanic | 12.8 | 17.4 | 0.307 | | - | - |
| Percent Asian | 1.2 | 2.7 | 0.406 | | - | - |
| Percent American Indian | 1.2 | 1.2 | 0.979 | | - | - |
| | | | | | | |
| Age | 44.7 | 48.2 | 0.001 | *** | 8.0 | 8.3 |
| Years at this school | 3.6 | 5.6 | <0.001 | *** | 1.0 | 4.3 |
| Years taught at this school | 0.0 | 0.8 | <0.001 | *** | 0.4 | 2.8 |
| Years assistant principal at this school | 0.0 | 1.0 | <0.001 | *** | 0.0 | 2.1 |
| Years principal at this school | 3.6 | 3.7 | 0.218 | | 1.0 | 0.7 |
| Total years taught | 7.3 | 10.3 | <0.001 | *** | 5.7 | 6.0 |
| Total years assistant principal | 0.4 | 3.2 | <0.001 | *** | 1.1 | 2.9 |
| Total years as principal | 3.8 | 3.8 | 0.470 | | 0.5 | 0.5 |

Notes: combined sample of principals, N=420 (86 APP principals and 334 comparison principals). *p* value is from a *t*-test for a difference in means. *** indicates statistically significant difference at the 0.01 level; ** indicates statistically significant difference at the 0.05 level. Missing data on age and select experience variables for a small number of APP and comparison principals.

Figure 2 illustrates that there is more variation in age among comparison principals and that the APP principal distribution leans more toward younger principals. APP principals were younger on average than comparison principals, with a mean age of 40.9 years at the start of their service versus 44.4 years for the comparison group (a statistically significant difference). Where 29 percent of APP principals were age 40 or younger at the start of service, 20 percent of comparison principals were this young. Likewise, 45 percent of comparison principals were over age 50 at the start of their service, compared with 24 percent of APP principals.

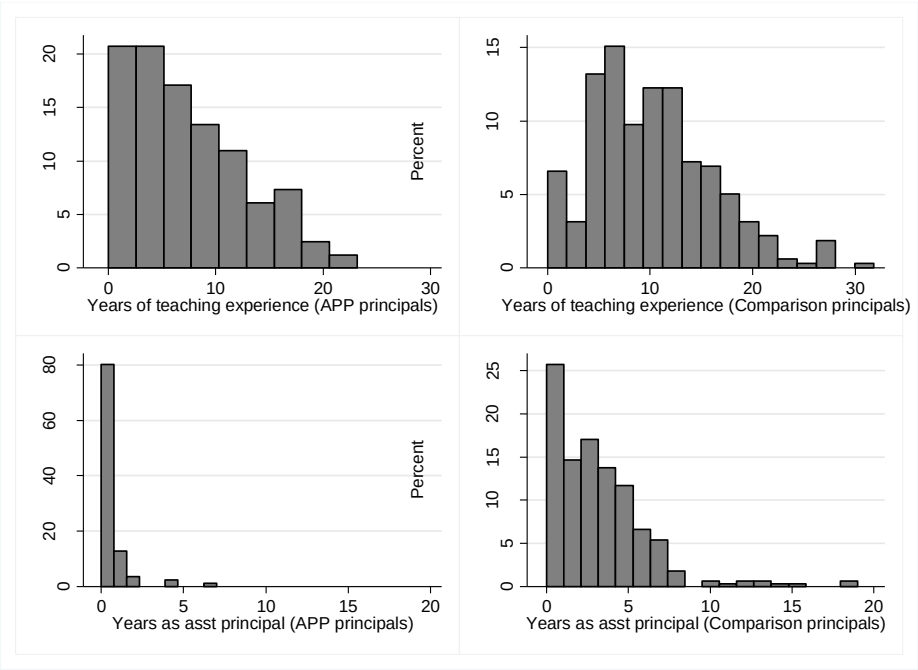
*Figure 2: Age at start of service as principal, APP and comparison principals*




Notes: combined sample of principals, N=400 (82 APP and 318 CP). Some principals missing age data.

Both groups have substantial experience in the classroom. Together, the group averaged 9.7 years of teaching experience. However, APP principals on average had three fewer years of teaching experience than comparison principals, at 7.3 versus 10.3 years (a statistically significant difference). A sharper difference between APP and comparison principals is evident in their experience as assistant principals. Seventy-eight percent of APP principals had no prior experience as an assistant principal, while most comparison principals (82 percent) had some experience in this position. Comparison principals averaged 3.2 years as assistant principal, and 23 percent had worked five or more years as assistant principals (see Figure 3). Because we selected principals for the study based on their tenure as principal, the APP and comparison samples are balanced with respect to this variable, averaging 3.6 years.

*Figure 3: Distribution of teaching and assistant principal experience, APP and comparison principals*




Notes: combined sample of principals, N=420 (86 APP and 334 CP).

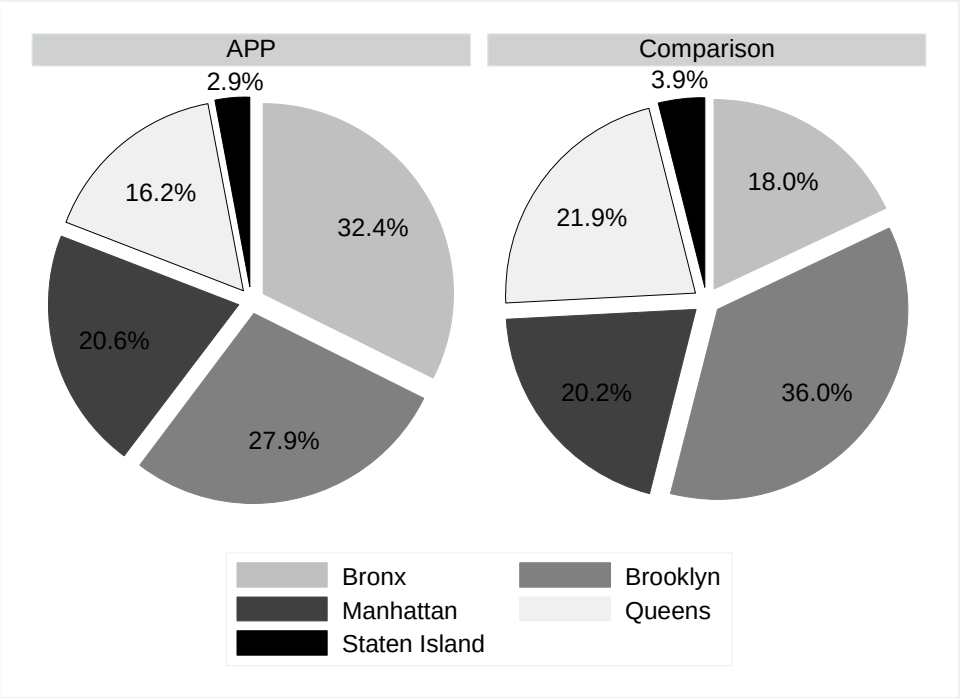
Finally, we observe that comparison principals had worked at their respective schools longer—in positions other than principal—than APP principals. Comparison principals had spent an average of 5.6 years at their schools, as compared with 3.6 for APP principals. A sizable fraction (31 percent) of comparison principals became a principal in the same school where they had worked as a teacher or assistant principal. This was true for just one APP principal. Virtually all APP principals gained teaching experience in another school.

Of course, these differences in work experience are an explicit design feature of the Aspiring Principals Program—because of labor market shortages particularly in hard-to-staff schools, future school leaders are prepared to advance into a principalship faster than they might have through other routes.

## IV. School Characteristics: Elementary and Middle Schools Led by APP and Comparison Principals

Figure 4 illustrates the distribution of APP and comparison schools serving elementary and middle grades, across boroughs. APP principals were more likely to be located in the Bronx (32 percent versus 18 percent of comparison principals), while comparison principals were more likely to be found in Brooklyn (36 percent versus 28 percent of APP principals) and Queens (22 percent versus 16 percent of APP principals).

***Figure 4: Distribution of APP and comparison elementary/middle schools by borough***




Notes: elementary and middle school subsample, N=296 (68 APP and 228 comparison principals).

Differences in the characteristics of schools led by these principals partly reflect the different communities in which they were located. Panel A of Table 4 summarizes these characteristics using school data from the *initial year* of the principals' service. All student characteristics shown here are based on students in the *tested grades only* (3 to 8). These grades are of interest because they correspond to our later regression analysis of school performance in grades 3 to 8. As long as

students in untested grades are not demographically distinct from those in the tested grades within the same school, these statistics should approximate those of the school.

***Table 4: Mean characteristics of APP and comparison elementary and middle schools in the initial year***

| | Mean | | | |
|---|---|---|---|---|
| | APP | Comparison | *p* | |
| A. School and student characteristics | | | | |
| Enrollment | 403.3 | 439.2 | 0.467 | |
| Percent white enrollment | 4.9 | 14.3 | 0.038 | ** |
| Percent black enrollment | 42.9 | 31.4 | 0.079 | * |
| Percent Hispanic enrollment | 44.9 | 40.8 | 0.547 | |
| Percent Asian/other enrollment | 7.0 | 13.3 | 0.156 | |
| Percent recent immigrants | 6.5 | 6.5 | 0.998 | |
| Percent native born | 85.1 | 85.1 | 0.994 | |
| Percent female | 50.2 | 50.7 | 0.942 | |
| Percent free lunch eligible | 66.7 | 59.5 | 0.289 | |
| Percent limited English proficient | 9.9 | 9.7 | 0.949 | |
| Percent special education | 9.5 | 9.9 | 0.936 | |
| | | | | |
| B. Student performance measures | | | | |
| Standardized score, math | -0.293 | 0.000 | <0.001 | *** |
| Standardized score, ELA | -0.291 | -0.019 | <0.001 | *** |
| Scale score, math | 653.4 | 664.3 | 0.001 | *** |
| Scale score, ELA | 651.4 | 661.0 | 0.001 | *** |
| Percent Level 3 or 4 in math | 43.9 | 58.4 | <0.001 | *** |
| | | | | |
| Lag standardized score, math | -0.251 | -0.039 | <0.001 | *** |
| Lag standardized score, ELA | -0.218 | 0.022 | <0.001 | *** |
| Percent tested in both subjects | 88.2 | 87.5 | 0.869 | |
| Percent tested in math only | 7.3 | 8.7 | 0.710 | |
| Percent tested in ELA only | 0.5 | 0.5 | 0.998 | |
| Percent not tested | 4.0 | 3.3 | 0.791 | |
| Percent no lag score, math | 61.9 | 66.4 | 0.493 | |
| Percent no lag score, ELA | 63.3 | 68.1 | 0.458 | |
| Attendance rate | 91.4 | 92.5 | 0.748 | |
| Total per-pupil spending | 16255 | 15334 | 0.045 | ** |

Notes: elementary and middle school subsample, N=296 (68 APP and 228 comparison schools). *p* value is from a *t*-test for a difference in means. *** indicates statistically significant difference at the 0.01 level; ** indicates statistically significant difference at the 0.05 level; * indicates statistically significant difference at the 0.01 level.

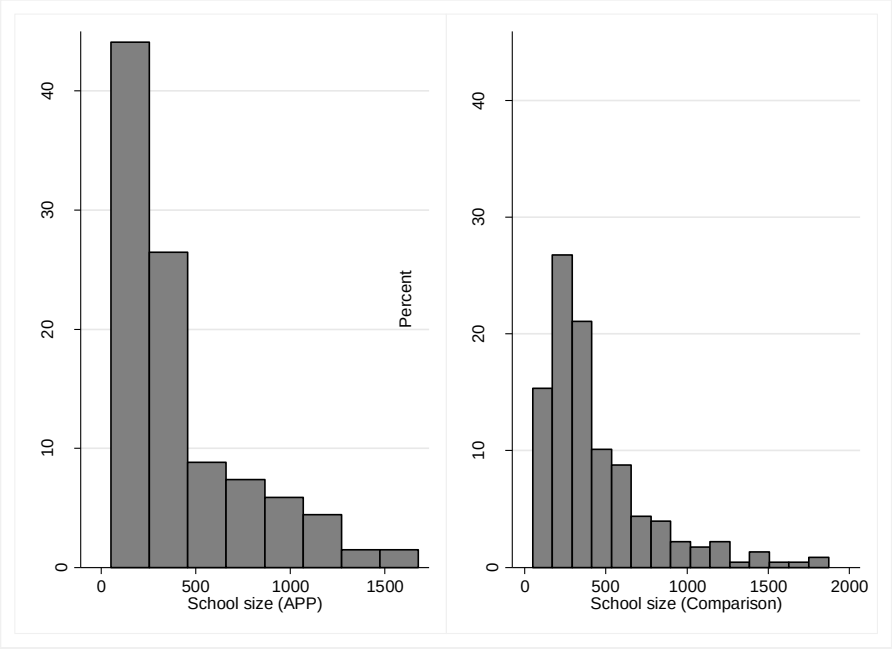
APP schools enrolled considerably fewer Asian and white students than comparison schools, and had a greater share of black and Hispanic students. Of these, only the differences in white and black enrollment shares are statistically significant, and the difference in the black share is sizable: 43 percent in APP schools versus 31 percent in comparison schools. The latter two differences are

statistically significant. Likewise, a greater share of students at APP schools was eligible to receive free lunch (67 percent versus 60 percent in comparison schools), though this difference is not statistically significant. Few differences were observed in the percent female, recent immigrant, native born, limited English proficient, and full-time special education.[14] Virtually the same fraction of students was tested in mathematics and/or ELA in the two types of schools, indicating little difference in test exemptions, on average. Average per-student spending was also similar. Attendance rates were comparable (91.4 percent in APP schools, versus 92.5 percent in comparison schools). Appendix Figure 1 provides the complete distribution of percent black, Hispanic, and eligible for free lunch within each school group in the initial year.

Lastly, the elementary/middle schools in which APP principals were located were somewhat smaller on average than those of comparison principals, although this difference is not statistically significant. Panel A of Table 4 shows that the average enrollment in elementary/middle schools was 403 for APP schools (in the first year of the principal's service) and 439 for comparison schools. The median school size was 282 and 343, respectively. Figure 5 illustrates the entire distribution of enrollment for the two groups of schools. Generally speaking, the distributions are quite similar, though APP principals were more likely to be placed in a school with fewer than 200 students enrolled.

[14] The percent receiving full-time special education in this case represents the percent of students in grades 3 to 8 in this category. Because many full-time special education students are not in graded classrooms, this understates the special education population in these schools.

*Figure 5: Initial year distribution of school size, APP and comparison schools serving elementary/middle grades*

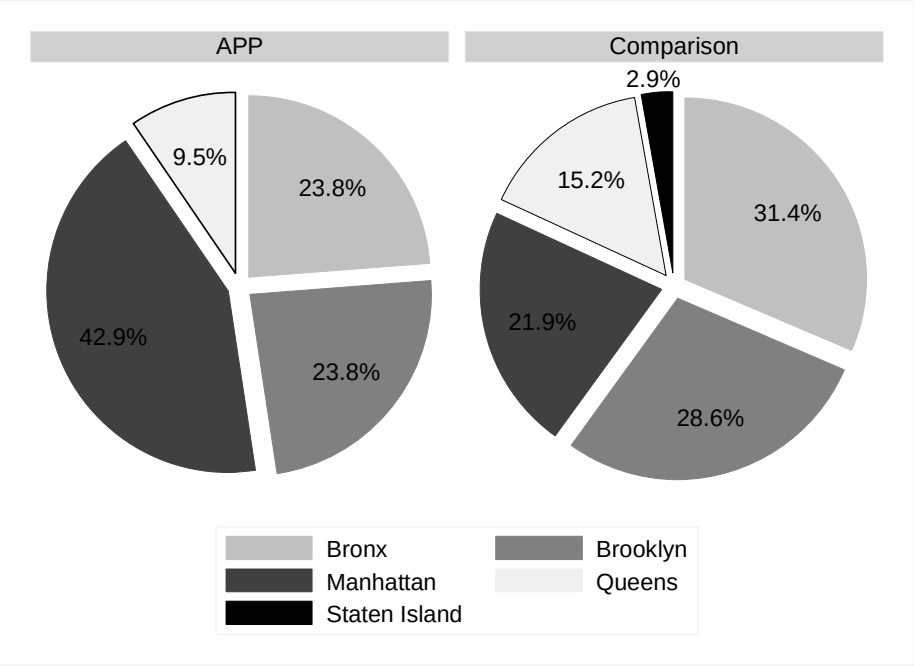



Notes: elementary/middle school subsample, N=296 (68 APP and 228 comparison principals, in their first year as principal (2005 or 2006)).

## V. School Characteristics: High Schools Led by APP and Comparison Principals

The distribution of APP and comparison high schools across boroughs differs from that of elementary and middle schools (compare Figure 6 and Figure 4). In contrast to the elementary and middle schools, new APP principals leading high schools were more likely to be located in Manhattan than new comparison principals (42.9% of APP versus 21.9% of comparison), while comparison principals were more likely to be leading schools in the Bronx (31.4%), Brooklyn (28.6%), and Queens (15.2%).

*Figure 6: Distribution of APP and comparison high schools by borough*




Notes: high school subsample, N=127 (22 APP and 105 comparison principals).

Panel A of Table 5 summarizes the mean characteristics of high schools using data from the principal's *initial* year of service. Because of the small number of schools in the APP group, only two of the differences observed here—school size and years of operation—are statistically significant at conventional levels. However, there are a number of differences in school characteristics worth noting. As was the case with the elementary and middle schools, APP schools had a larger share of black students (48.5 percent versus 40.4 percent) and significantly fewer Asian and white students. A larger share of APP school students were native born (81.2 percent versus 76.1 percent), and fewer were recent immigrants. Enrollment in APP high schools was also lower on average than in comparison high schools.

*Table 5: Mean characteristics of APP and comparison high schools in the initial year*

| | Means | | | |
|---|---|---|---|---|
| | APP | Comparison | *p* | |
| A. School and student characteristics | | | | |
| Enrollment | 317.8 | 595.4 | 0.002 | *** |
| Years school has been in operation | 7.4 | 4.4 | 0.006 | ** |
| Percent white enrollment | 3.8 | 7.7 | 0.521 | |
| Percent black enrollment | 48.5 | 40.4 | 0.492 | |
| Percent Hispanic enrollment | 40.1 | 42.1 | 0.867 | |
| Percent Asian/other enrollment | 4.2 | 7.0 | 0.635 | |
| Percent recent immigrants | 7.0 | 8.3 | 0.844 | |
| Percent native born | 81.2 | 76.1 | 0.613 | |
| Percent female | 53.2 | 53.6 | 0.967 | |
| Percent free lunch eligible | 58.8 | 59.7 | 0.940 | |
| Percent limited English proficient | 7.6 | 8.8 | 0.861 | |
| Percent special education | 13.6 | 10.9 | 0.724 | |
| B. Student performance measures | | | | |
| Regents: percent passing English (55+) | 79.1 | 89.0 | 0.211 | |
| Regents: percent passing math (55+) | 86.0 | 93.7 | 0.227 | |
| Regents: percent passing global history (55+) | 79.6 | 81.1 | 0.877 | |
| Regents: percent passing biology (55+) | 84.2 | 86.0 | 0.827 | |
| Regents: percent taking English | 23.8 | 21.3 | 0.802 | |
| Regents: percent taking math | 36.4 | 31.0 | 0.630 | |
| Regents: percent taking global history | 34.2 | 28.8 | 0.620 | |
| Regents: percent taking biology | 31.5 | 28.4 | 0.771 | |
| Percent passing ten or more credits | 28.7 | 32.6 | 0.725 | |
| Attendance rate | 72.3 | 73.3 | 0.929 | |
| 4-year graduation rate (where available) | 55.3 | 44.8 | 0.288 | |

Notes: high school subsample, N=126 (21 APP and 105 comparison schools). The four-year graduation rate is only observed for 10 APP schools and 51 comparison schools). *p* value is from a *t*-test for a difference in means. *** indicates statistically significant difference at the 0.01 level.

As shown in Panel A of Table 5, enrollment in APP high schools averaged 318 while enrollment in comparison schools averaged 595, a statistically significant difference. While the *median* school size was lower for comparison high schools (252 versus 286 in APP schools), comparison principals were more likely to be located in very large high schools. The largest school led by an APP principal enrolled 864 students, while 15 percent of comparison principals began work in a school of 1,000 or more students.

Our sample of high schools included a large number of new schools. Panel A of Table 5 indicates that APP principals led an older set of schools, on average, than comparison schools. This difference, however, is attributable mainly to the small sample of schools. Of the 21 APP principals, 9 (or 43 percent) were leading new schools (a list of all APP high schools is provided in Appendix Table 6). A similar proportion of comparison principals (47 percent) had taken the helm of new schools. Because a greater share of APP principals led older schools, the APP average appears to be much higher than the comparison group. Again, due to the large number of new schools we are very limited in the kinds of "pre" and "post" comparisons that can be made for high schools.

## VI. Average Achievement in APP and Comparison Schools

### Measures and definitions

For elementary and middle schools, our primary student outcome measures are average test scores on the New York State exams in English Language Arts (ELA) and mathematics, administered in 3rd through 8th grade. At the high school level, our key school performance measures are passing rates on the Regents exams (Comprehensive English, Mathematics "A," Global History, and Biology), four-year cohort graduation rates, and annual rates of credit accumulation. [15]

Test performance on the ELA and mathematics tests can be expressed in three ways: scale scores, performance levels, and standardized scores. A student's *scale score* is a re-scaled version of his/her number of correct test answers. This scale score ranges from (roughly) 470 to 800, and is intended to be comparable across grades.[16] A school's *average scale score* in a given subject is simply the average of its students' scale scores on that subject's test.

[15] Four- year graduation rates are taken from the *Annual School Report Cards*.
[16] The New York State tests are not "vertically scaled." That is, the scale scores from these tests cannot be used to measure student progress from grade to grade on a continuum of learned skills. Rather, student progress can only be measured relative to proficiency in meeting the state standards. It is for this reason that New York does not provide averages of scale scores across grades. For more information, see the New York City Department of Education's guide

*Performance levels* are discrete ranges of scale scores determined by state educational standards: Level 1 (Not Meeting Learning Standards), Level 2 (Partially Meeting Learning Standards), Level 3 (Meeting Learning Standards) and Level 4 (Meeting Learning Standards with Distinction). Students scoring at Level 3 or Level 4 on a given subject exam are considered to be "proficient" in that subject, or meeting state standards. A school's *proficiency rate* in a given subject is the percent of students reaching Level 3 or 4 in that subject.

Finally, a *standardized score* (also known as a "*z*"-score) indicates where a student's scale score falls in the *distribution* of test scores. This score is calculated as the difference between a student's scale score and the city average score, divided by the overall standard deviation in test scores.[17] (This calculation is done with respect to the student's *own grade*). Its interpretation is straightforward: a student's standardized score tells us how far he/she scored from the city average test-taker in his/her grade, in standard deviation units. A standardized score of 1.5 indicates a student scored 1.5 standard deviations above average. Similarly, a standardized score of -0.3 indicates a student who scored 0.3 standard deviations below average.[18] A score at grade level average has a standardized score of zero. At the school level, the *average standardized score* in a given subject is simply the average of its students' standardized scores on that test.

Each of these three measures has advantages and shortcomings. Scale scores are an "absolute" measure of performance, but the citywide (and statewide) average fluctuates from year to year and is sensitive to test inflation or changes in test design. Cross-grade comparisons of scale scores may be problematic in practice, even if they are intended to be comparable. These problems

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to the state tests here: http://schools.nyc.gov/Accountability/YearlyTesting/TestInformation/Tests/default.htm and the New York State Department of Education documentation here: http://www.emsc.nysed.gov/irts/ela-math/. For a readable explanation of these concepts used in this section, see Koretz (2008).

[17] The standard deviation is a measure of dispersion, or variation, in scores. Loosely, it can be thought of as how far away from the mean the average student scored. If all students receive the same score, the standard deviation is zero.

[18] When test scores are distributed normally, roughly 68 percent of students fall between 1 standard deviation below and 1 standard deviation above the mean. Similarly, roughly 95 percent fall between 2 standard deviations below and 2 standard deviations above the mean.

may stem from the lack of vertical scaling, or shifts over time in the grade composition of schools.[19] Proficiency rates are easy to understand "absolute" measures of performance, and are the most commonly cited student achievement measure as the centerpiece of *No Child Left Behind*. They are also a critical component of the New York City School Progress Reports. On the other hand, they mask a great deal of information and frequently provide misleading comparisons of school performance.[20]

While less transparent to the average reader, standardized scores address most of the shortcomings cited above. Their use is standard practice in educational research and evaluation, given their comparability across tests, across grades, and over time. We report mean scale scores and average proficiency rates for APP and comparison schools only in this section, and we rely strictly on standardized scores in our regression analysis in Sections VII – VIII. In addition to contemporaneous standardized scores, we also calculate for each school their students' average standardized scores from the *prior year*.[21] In other words, these lagged standardized scores represent the average achievement of a school's currently enrolled students who were tested in the prior year.

In the case of the Regents exams, we define passing as a score of 55 or higher, the minimum for a local diploma during this period. The minimum passing score for a Regents' diploma is 65. Regents exam results were available for all years of our high school data series (2003-04 to 2007-08), while graduation rates were only available through 2006-07.[22] Because many of the high schools in

[19] A comparison of average scale scores for two schools at two points in time may make sense if the grade composition of these schools remains constant. But if one school increases its population of 6th graders (for example) relative to the other, and 6th grade scale scores are typically lower than other grades, then the former school will be "penalized" for its growth in its 6th grade population.

[20] To illustrate, suppose two schools make equal improvements in their students' scale scores. Assume the first school's students were originally just below the Level 3 cut score and the second's were much further below the cut score. Even if the two schools make identical progress, the first school's proficiency rate is likely to rise much more than the second. This example can be extended to include a third school where many students are already above the Level 3 threshold, but still make the same progress in scale scores as the other two schools. In this case, the first school will appear to have significantly greater "gains," as measured by proficiency rates, than both the second and third school.

[21] Only students with scores observed in the prior year can be used in this calculation. Because 3rd grade is the first year of testing, none of the students in this grade have lagged scale scores.

[22] Four-year cohort graduation rates for 2007-08 were not available as of this writing.

our analysis were new in 2005 or 2006, many do not yet have four-year cohort graduation rates available. We do have a benchmark measure of credit accumulation, which indicates the percent of students in grades 9 – 12 who passed ten or more credits in a given academic year.

The only other measure at both the elementary/middle and high school levels that might be considered an outcome is the average rate of student attendance. There tends to be little variation in attendance at the elementary/middle school levels (most of the elementary and middle schools in our study have attendance rates of 90 percent or higher). However, we do observe more variation at the high school level, where half of our school observations have attendance rates that fall between 59 percent and 78 percent (with a mean of 62 percent). We do not use attendance rates as an outcome measure in this report, but plan to do so in future research.

### Initial year achievement in APP and comparison schools

A comparison of average mathematics and ELA achievement in APP and comparison schools reveals stark differences in APP and comparison schools *before* the arrival of their new principals.[23] As shown in Panel B of Table 4, which presents the average achievement in APP and comparison schools in the principal's initial year of service, students at APP schools performed substantially lower on the state ELA and mathematics tests, with students scoring an average of 0.29 standard deviations below their grade-level mean.[24] Students at comparison schools scored mostly at grade-level mean, on average. Appendix Figure 2 illustrates the complete distribution of school-level average standardized scores, by group, in the principals' initial year.

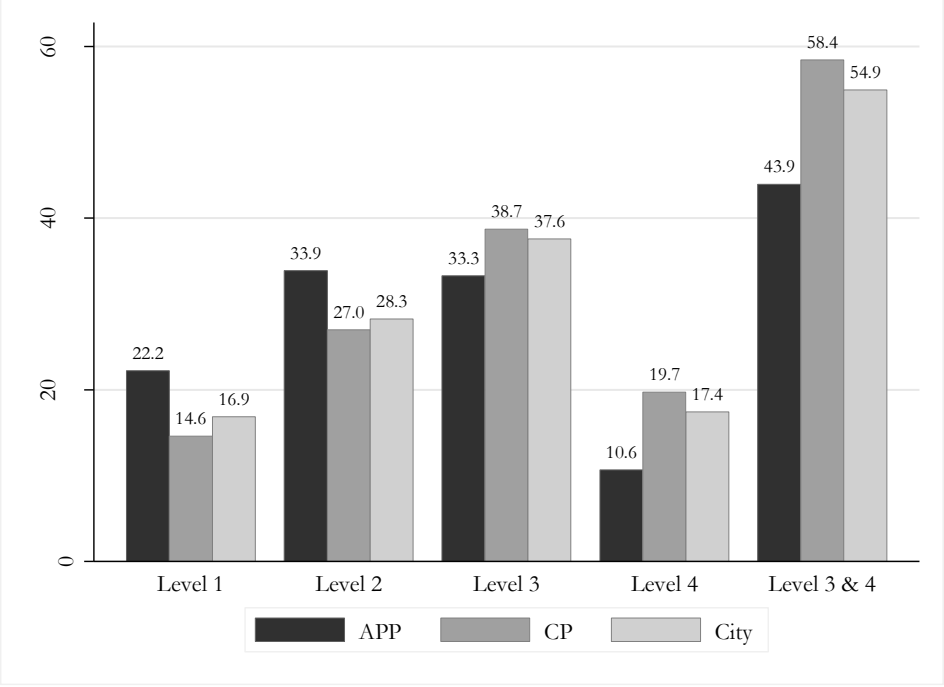
[23] As we noted in Section II, we refer to schools eventually lead by an APP principal as "APP schools." "Comparison schools" are schools eventually lead by a comparison group principal.

[24] We use the principal's initial year of service to describe the conditions of the school in the year the principal took the helm of that school. It is possible, of course, that a principal can have an immediate impact on their school in his or her first year. Many of the principals in our sample, however, took the leadership of a school in the middle of the academic year. For this reason, we assume here that the initial year impact is relatively modest. In our regression analysis we are able to relax this assumption and examine changes in the principal's first year.

When comparing average *lagged* performance of students in ELA and mathematics—that is, the average performance of students enrolled in APP and comparison schools in the prior year—we observe an identical pattern (Panel B of Table 4). Students attending APP schools on average scored 0.25 standard deviations below their grade level average in mathematics and ELA in the prior year. Students in comparison schools scored 0.02 to 0.04 of a standard deviation below their grade level average in the prior year.

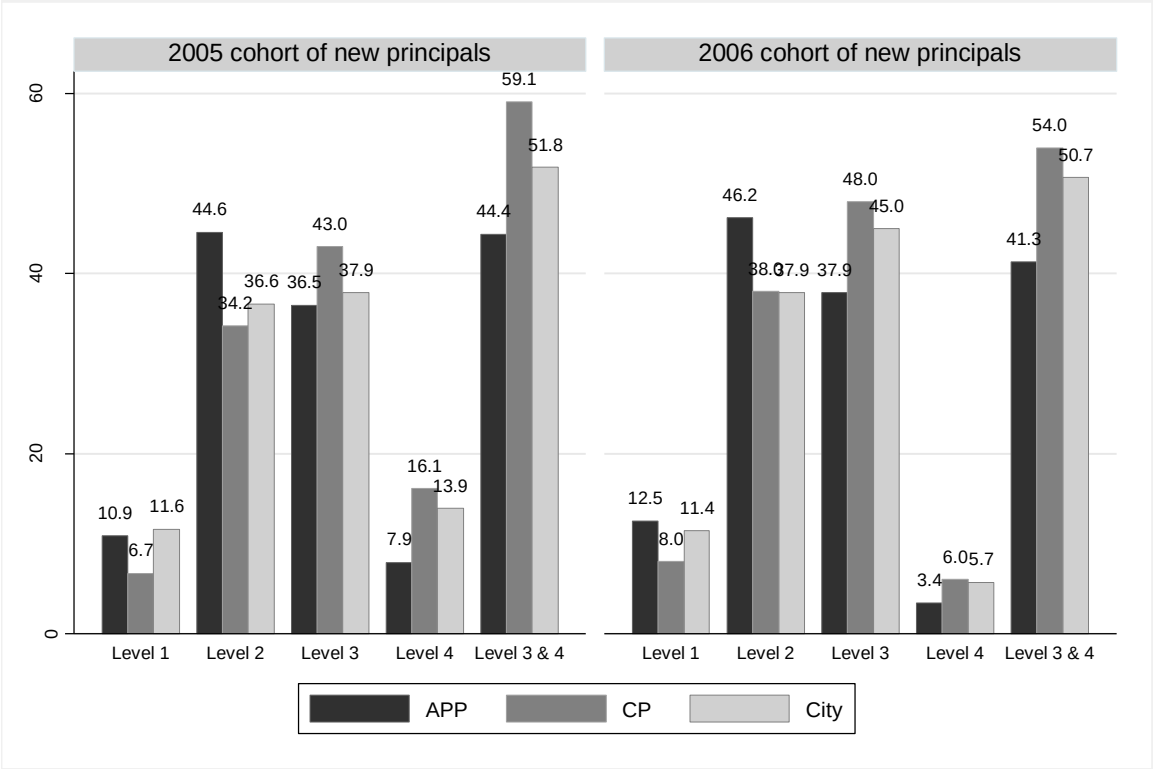
Figures 7 and 8 present these initial differences between APP and comparison schools another way: in terms of proficiency levels. For example, in their principals' first year 58.4 percent of comparison schools' students were proficient in mathematics (level 3 or 4) compared with 43.9 percent of APP school students. A similar gap is observed for proficiency in ELA. APP schools also averaged a large fraction of low achieving students, with 22.2 percent performing at level 1 in mathematics.

***Figure 7: Initial year performance levels in mathematics, APP and comparison schools***




Notes: elementary and middle school subsample, N=296 (68 APP and 228 comparison principals). Scores reflect the average for the school in the principal's first year of service (2005 or 2006).

*Figure 8: Initial year performance levels in ELA, APP and comparison schools serving elementary and middle grades by start cohort*




Notes: graph produced separately for 2005 and 2006 cohorts due to change in the ELA test between these years.

Differences in initial student performance are also observed at the high school level, as seen in Panel B of Table 5. However, because of our small sample of APP schools, none of these differences are statistically significant. Of those who took the exam, 79 percent of APP high school students earned a passing grade on the English Regents exam versus 89 percent of comparison school students. This pattern was similar in mathematics, history, and biology. These differences appear to be partly driven by the fraction of students in these schools taking the Regents. Generally speaking, a larger share of students in APP schools took the Regents exams, relative to comparison schools. For example, 36 percent of students in APP schools took the Mathematics A Regents in the initial year, as compared with 31 percent in comparison schools. Four-year graduation rates were higher among APP schools, at 55.3 percent (versus comparison schools' rate of 44.8 percent),

though this difference is not statistically significant. Finally, the fraction of high school students earning 10 or more credits in the principal's initial year was lower among APP schools (28.7 percent) than comparison schools (32.6 percent).

As emphasized above, all comparisons of high school achievement in this report should be made with caution because of the small sample of APP high schools. This is particularly problematic for the graduation rates, given only 10 APP and 51 comparison high schools had graduation data available.

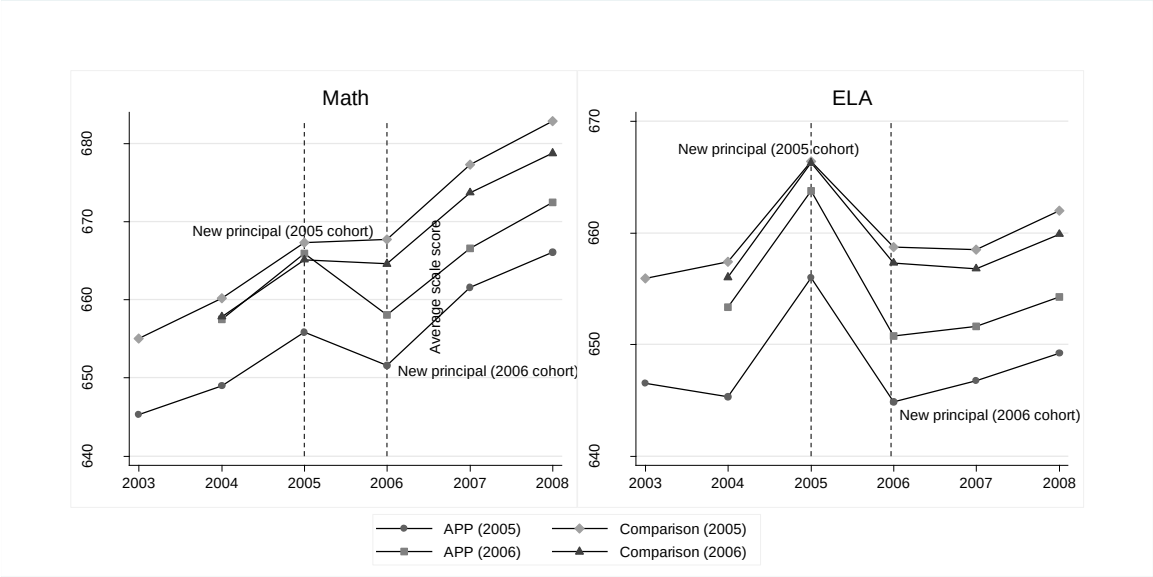
### Achievement trends in APP and comparison schools

All comparisons of student achievement made thus far reflect a single point in time—the principal's initial year of service. An alternative view of student performance is provided in Figures 9 - 12, which show average achievement in APP and comparison schools over time. These figures track average achievement in these schools both *before* and *after* the arrival of their new principal. It is important to emphasize that these figures represent simple averages that do not take into account differences in student characteristics or prior achievement. Our regression analyses in Sections VII and VIII do make such adjustments. Furthermore, in the cases where we use standardized scores, we re-emphasize that these measures represent *relative* achievement—that is, the average student's test performance relative to the citywide grade-level average in a given year.

Figure 9 shows that average scale scores in APP and comparison schools were generally on an upward trend during this six-year period, as was the case citywide. The initial differences in APP and comparison schools are also evident here; in the years preceding the installation of a new principal, APP schools' average scale scores were significantly below those of comparison schools. This difference was especially true for the 2005 cohort, in both subjects, and for the 2006 cohort in

ELA. One should use appropriate caution when interpreting the time trend in ELA; because the test changed between 2005 and 2006, these average scores are not directly comparable.[25]

***Figure 9: Average scale scores in mathematics and ELA, constant cohorts of APP and comparison schools serving elementary and middle grades, 2003-2008***



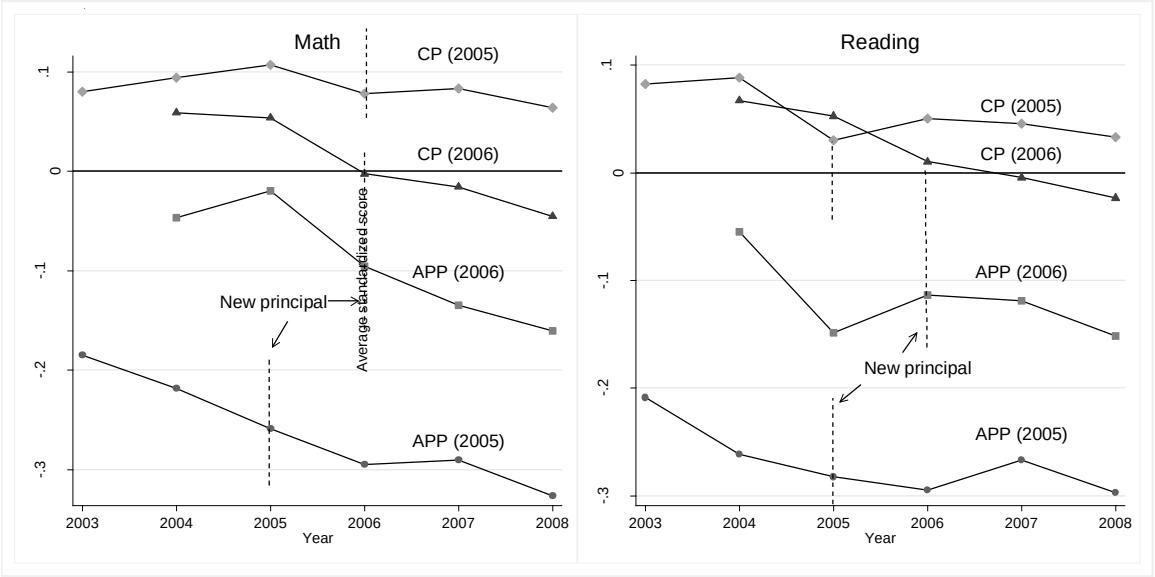

Notes: "APP school" refers to a school in which an APP principal took over (in 2005 or 2006). "Comparison school" (CP) refers to a school in which a comparison principal took over (in 2005 or 2006). Dotted lines indicate years in which the new principal was installed. The 2005 new principal cohort includes 27 APP schools and 90 comparison schools observed every year from 2003 to 2008. 2006 new principal cohort includes 19 APP and 95 comparison schools observed every year from 2004 to 2008. Note the *ELA exam changed formats* in 2006.

In Figure 10, we compare trends in average *standardized scores* of APP and comparison elementary and middle schools. We do this by first dividing these schools into four cohorts: (1) APP schools where a new principal was installed in 2005, (2) comparison schools with a new principal in 2005, (3) APP schools with a new principal in 2006, and (4) comparison schools with a new principal in 2006. For all four cohorts we observe average student achievement for two years prior to the arrival of the new principal. All schools included in these figures were observed

[25]Appendix Figure 3 provides trends in 4th grade ELA scores alone. The content and format of the test in this grade remained constant over this period.

continuously for the entire period, and represent a subset of sample schools.[26] Dotted lines indicate years in which the new principals were installed.

***Figure 10: Average standardized scores in mathematics and ELA, constant cohorts of APP and comparison schools serving elementary and middle grades, 2003 – 2008***




Notes: "APP school" refers to a school in which an APP principal took over (in 2005 or 2006). "Comparison school" (CP) refers to a school in which a comparison principal took over (in 2005 or 2006). Dotted lines indicate years in which the new principal was installed. The 2005 new principal cohort includes 27 APP schools and 90 comparison schools observed every year from 2003 to 2008. 2006 new principal cohort includes 19 APP and 95 comparison schools observed every year from 2004 to 2008.

Figure 10 reveals that mathematics and ELA achievement in APP elementary and middle schools were on a downward trajectory *prior to the arrival* of the new APP principals. Further, this trajectory differed from that experienced by comparison schools prior to the arrival of their new principals. This trend is particularly true for schools led by the 2005 cohort of APP principals. For this cohort, the average standardized score in mathematics fell 40 percent, from -0.185 to -0.259

[26]To be included in Figure 10, a school must have been observed *continuously* from at least two years before the installation of a new principal through the 2007-08 school year. In other words, the set of schools included in each cohort is held constant throughout the entire period. This includes 27 and 19 APP schools and 90 and 95 comparison schools in the 2005 and 2006 cohorts, respectively. These schools represent 2/3 of all elementary and middle APP schools and 80 percent of all comparison schools. As Appendix Table 2 shows, the remaining schools did not have complete data over this entire period (for example, they may have been missing data for one year, or only had one year of results prior to the arrival of the new principal).

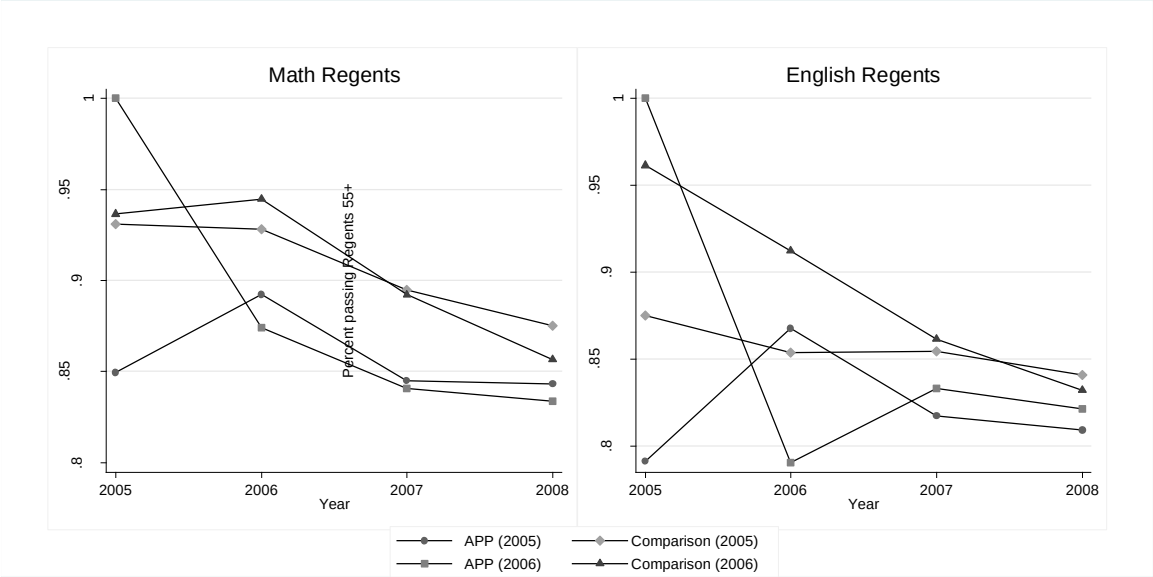
between 2003 and 2005, the years leading up to and including the APP principal's initial year. Average standardized scores in ELA fell from -0.209 to -0.282 over the same period. By contrast, in comparison schools average mathematics achievement *rose* during these same three years and fell only slightly in ELA. In both ELA and mathematics, average achievement in the 2005 cohort of APP schools stabilized somewhat after the arrival of the new principal, but dipped again in 2008 (in relative terms; recall these are standardized scores).

The initial downward trend in student performance on the state exams was less strong among the 2006 cohort of APP schools. In this case, average achievement in mathematics fell from -0.047 to -0.096 between 2004 and 2006—the years leading up to and including the principal's initial year—and in ELA from -0.055 to -0.114. (Scores in mathematics increased from 2004 to 2005, but fell again in 2006). Performance fell to a similar extent among the 2006 cohort of comparison schools in these years, in both subjects. At least in mathematics, the relative achievement of the 2006 APP cohort continued to fall, but at a more modest rate than the years prior.

Figure 11 provides an analogous view of achievement in APP and comparison high schools, measured using average passing rates on the Mathematics "A" and English Regents exams (of those students who write the exam). Due to the very small number of school observations used here, these statistics and their interpretations should be taken with appropriate caution.[27] Passing rates on the Regents exam scores during this period ranged from 79 to 93 percent (among those who took the test), but the trend from 2006 was unmistakably downward for schools in all four groups. APP schools generally had lower pass rates than comparison schools in almost all years, with some suggestive evidence that these schools converged over time (mainly due to a faster rate of decline among comparison schools).

[27]Again, in Figures 11-12 the set of schools included in each cohort is held constant throughout the entire period. This includes 12 and 9 APP schools and 65 and 39 comparison schools in the 2005 and 2006 cohorts, respectively. Note that the 2005 cohort used here does *not* include a pre-2005 observation (too little data was available prior to 2005 to make this restriction). The 2006 cohort includes one year of pre-2006 data.

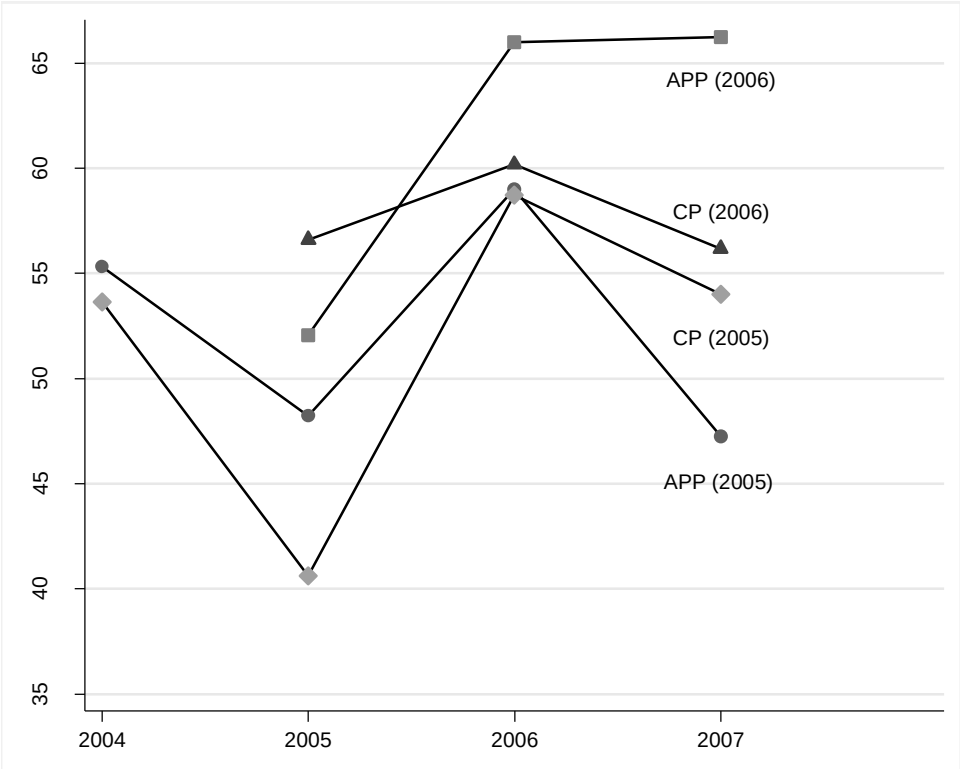
***Figure 11: Average pass rates in Mathematics and English Regents exams, constant cohorts of APP and comparison high schools, 2005 – 2008***




Notes: 2005 new principal cohort includes 12 APP schools and 65 comparison schools observed every year from 2005 to 2008 (*note there are no "before new principal" observations in this case*). 2006 new principal cohort includes 9 APP schools and 39 comparison schools observed every year from 2005 to 2008 (the first year precedes the new principal).

Figure 12 illustrates the trend in average four-year graduation rates for these same four cohorts of high schools, at least for the small number of schools for which we have this data. Graduation rates improved between 2005 and 2007 for most cohorts, with the exception of the 2005 cohort of APP schools, in which graduation rates fell from 59.0 percent to 47.3 percent between 2006 and 2007, after rising from 2005 to 2006. Again, the number of schools used in these calculations is very small, especially for the APP cohorts. Consequently, the inferences we can draw from these comparisons are quite limited.

*Figure 12: High school graduation rates, APP and comparison high schools, 2004 – 2007*

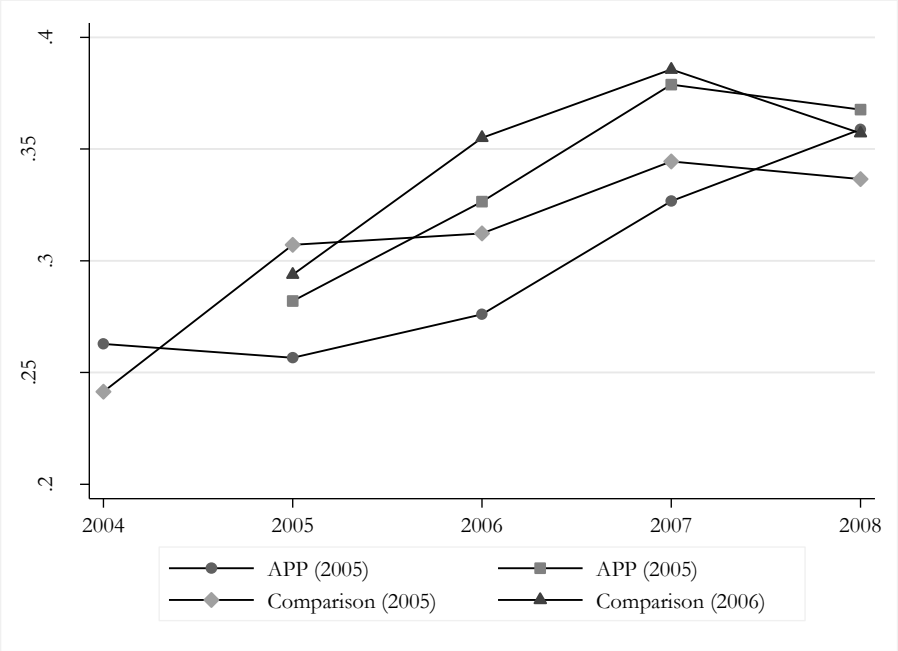



Notes: 2005 new principal cohorts include 8 APP and 30 comparison principals in 2004 (the year prior to the new principal) and 12 APP and 65 comparison principals in 2005 – 2007. The 2006 new principal cohorts include 9 APP and 39 principals in all years.

Finally, Figure 13 shows the trends in the school average rate of students earning ten or more credits in each year (a measure of "satisfactory progress" toward graduation); the cohorts identical to those used in Figure 12. The fraction of students making satisfactory progress was on a general upward trend for all groups, rising from 26 – 31 percent in 2005 to 34 – 38 percent in 2006. The 2005 cohort of APP schools appears to have improved at the fastest rate, from an average of 25.7 percent of students earning 10 or more credits in 2005—the principal's first year—to 35.9 percent in 2006. By comparison the 2005 cohort of comparison schools rose from an average of 30.7 percent to 33.7 percent. Similarly, the 2006 cohort of APP schools improved from an average

of 28.2 percent of students making satisfactory progress to 36.8 percent. As before, the number of schools used in these calculations is very small.

***Figure 13: Credit accumulation, APP and comparison high schools, 2004 – 2007***




Notes: 2005 new principal cohorts include 8 APP and 30 comparison principals in 2004 (the year prior to the new principal) and 12 APP and 65 comparison principals in 2005 – 2007. The 2006 new principal cohorts include 9 APP and 39 principals in all years.

## Summary

In this section we provided a comparison of average student achievement in APP and comparison schools, both in the principals' initial year and in years before and after the installation of a new principal. We found significant differences in the average achievement in mathematics and ELA at APP and comparison schools, with students at APP schools performing at lower levels—an achievement gap that *preceded* the arrival of the new principals. In the principals' initial year, students in APP schools were already performing below their citywide grade level average, while students in comparison schools performed roughly at their grade level average. At the high school level, students at APP schools who took the Regents exams performed somewhat lower on these tests than students at comparison schools (though this sample is small).

An important difference between APP schools and comparison schools was revealed in Figure 10. Schools where an APP principal was placed were generally on a sharp downward trend in mathematics and ELA in the years preceding the new principal. This was especially evident for the 2005 cohort of APP schools. Comparison schools, by contrast, experienced relatively stable performance in these subjects prior to their new principal.

We emphasize that the results presented in this section are only simple comparisons of group averages. As is true for all analyses of school-level performance, there is likely to be a myriad of other factors not accounted for here that partly explain observed differences in test scores. These factors include student composition such as poverty (which varies both between schools and within schools over time) and prior achievement. Our regression analyses in the following sections explicitly attempt to account for these differences.

## VII. Regression Analysis: Elementary and Middle Schools

### Overview of the analytical approach

As shown in Section IV - VI, the first two cohorts of APP principals were placed in schools that were demographically, geographically, and academically distinct from comparison schools led by other new principals. Elementary and middle school APP principals were almost twice as likely to be located in the Bronx, and the average student attending these schools was significantly more likely to be black and slightly more likely to be poor. Most importantly, elementary and middle school APP principals were disproportionately placed in schools that were already lower achieving, on average, than their peer schools led by other new principals. Average achievement in APP schools was largely on a downward trend, relative to the city average, prior to the arrival of the APP principals.

In this section, we provide a more formal comparison of outcomes in elementary and middle schools led by APP and comparison principals. This analysis involves estimating a series of multiple

regression models that attempt to compare performance in APP and comparison schools after *controlling for* observable differences between these groups of schools (including prior year performance of students in those schools).

Here we rely strictly on *average standardized scores* as our measure of ELA and mathematics achievement. As explained in Section VI, these measures are the most reliable for making comparisons between schools, across grades, and over time. The reader should keep in mind that these are measures of *relative* performance; they indicate how the average student in a school performed relative to his/her citywide grade level average. These scores are in *standard deviation* units—a measure of the overall grade-level variation in scores. A standardized score of 1, for example, indicates that the average student scored one standard deviation above their grade level average. All of the standardized scores used here are school-level averages.[28]

As described in the Methodological Appendix, we begin by estimating a simple "difference-in-difference" regression model that compares APP school outcomes before and after the arrival of their APP principal with comparison school outcomes before and after the arrival of their new principal. This approach allows achievement in APP and comparison schools to differ in the years before the new principal (which we know from Section VI to be true) as well as after. We can then test whether APP schools experienced greater *improvements* in average achievement after the installation of new leadership than similar comparison schools.[29]

We then extend this model by estimating a difference-in-difference regression model with school-level "fixed effects." Because we observe most APP and comparison schools before and after the arrival of a new principal, we can effectively allow each school to have its own baseline

[28] Across all *schools* in our sample, the standard deviation of these school-level average scores is approximately 0.48 in math and 0.45 in ELA.

[29] Our model does not make use of *student*-level achievement gains. Rather, we are comparing average school scores in a given year conditional on the average score of students in that school, in the prior year. Further, these average scores are *standardized,* meaning they are all interpreted relative to the citywide average.

level of achievement. In this case, changes in outcomes *within schools over time* provide our estimate of APP effects. While this is our preferred model, it relies on having a sufficient number of schools observed both before and after the arrival of a new principal.

In all cases, our regression model controls for the average prior year test scores for the students in each school.[30] We also provide regression estimates that alternately include and exclude other school-level controls, such as the student racial and gender composition, percent eligible for free lunch, percent native born or immigrant, and the like. Our findings are largely unaffected by the inclusion of these controls. We have also estimated all models *without* controlling for prior year test scores, and with and without controls for the percent of students not tested; again, the results are quite similar.

As a final extension, we re-estimate all of the above models under an alternative specification where APP and comparison schools are allowed to have different pre- and post-new principal *trends*. In these models, "one year before new principal" represents the baseline one reference year, while "two or more years before new principal," "first year under new principal," "second year under new principal," and "third or later year under new principal" are differences in average achievement relative to the baseline year. This approach allows us to examine whether these two types of schools followed different trajectories prior to the new principal (as was suggested in Figure 10), as well as whether these schools followed different trajectories *after* the new principal took the helm. As we discuss below, this alternative model proves to be informative.

### Results

Table 6 presents results from our basic difference-in-difference regression model for elementary and middle school ELA and mathematics. Columns (1) – (4) provide coefficient

[30] Controlling for prior year achievement is similar in spirit to more refined "value-added" models. Bear in mind that our measures of contemporaneous and lagged achievement are generated from individual student-level data.

estimates from a model with no additional school controls beyond lagged student achievement and school level (PK6, PK9, MS, MS/HS) while columns (5) – (8) present estimates from models with a full set of controls.[31] The models represented in columns (3) – (4) and (7) – (8) include school fixed effects.

***Table 6: Regression results for standardized mathematics and ELA scores, elementary and middle schools***

| | Basic Model | | | | Model with Controls | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA | (7) Math | (8) ELA |
| Prior year standardized score | 0.905*** (0.035) | 0.895*** (0.035) | 0.410*** (0.055) | 0.370*** (0.051) | 0.739*** (0.075) | 0.706*** (0.071) | 0.367*** (0.056) | 0.323*** (0.047) |
| APP school (before new principal) | -0.018 (0.019) | -0.056** (0.020) | | | -0.013 (0.018) | -0.054** (0.020) | | |
| Post new principal | 0.018 (0.012) | -0.022* (0.008) | -0.016 (0.009) | -0.041*** (0.007) | -0.008 (0.017) | -0.043*** (0.011) | -0.028** (0.010) | -0.034*** (0.008) |
| **APP * post new principal** | **-0.049** (0.019)** | **0.014 (0.016)** | **-0.040* (0.018)** | **0.016 (0.015)** | **-0.042* (0.018)** | **0.012 (0.017)** | **-0.033 (0.018)** | **0.019 (0.015)** |
| School fixed effects | NO | NO | YES | YES | NO | NO | YES | YES |
| Constant | 0.001 (0.012) | -0.031** (0.011) | -0.007 (0.006) | -0.008 (0.005) | 0.057 (0.058) | 0.092 (0.053) | 0.199 (0.159) | 0.413** (0.147) |
| N | 1625 | 1623 | 1625 | 1623 | 1599 | 1597 | 1599 | 1597 |

Notes: see Appendix Table 3 for the full set of coefficient estimates. Regressions in columns (5) – (8) control for average student characteristics and per-pupil spending; columns (1), (2), (5), and (6) control for school level; (5) and (6) additionally control for borough effects. In columns (1), (2), (5), and (6) standard errors allow for clustering by school. Columns (3), (4), (7) and (8) are estimates from fixed effects models with robust standard errors in parentheses. * $p<0.05$, ** $p<0.01$, *** $p<0.001$.

Controlling for lagged achievement, we find that APP schools on average had lower *pre-existing* levels of achievement relative to comparison schools. This comports with our finding in Figures 9-10 that showed APP schools were initially lower performing. In Table 6, this difference is visible in the "APP school (before new principal)" coefficient, which represents the initial gap between APP and comparison schools (comparison schools are the omitted reference group). This initial difference is statistically significant in mathematics, at 0.056 standard deviations. A smaller and

[31] For readability we do not include coefficient estimates for the additional control variables in Table 6. The full table of estimates can be found in Appendix Table 3.

statistically insignificant difference of 0.018 is observed in ELA. These estimates are virtually the same when including a full set of school controls (columns (5) – (8)).

Interestingly, relative student test performance falls modestly in the years following the installation of a new principal, in both APP and comparison schools. This finding may represent a "transition" effect for new principals, not unlike those observed for novice teachers, who are found to be less effective than their peers in their first few years of teaching.[32] In Table 6, this difference is seen in the "post new principal" coefficient, which applies to both school types. We find that average standardized scores in ELA are lower by 0.022 to 0.043 standard deviations after the arrival of a new principal (a statistically significant difference). Scores in mathematics are as much as 0.028 standard deviations lower. This finding is robust to the inclusion of school fixed effects; in our full model with controls and fixed effects, we find a statistically significant negative relationship between new principals and achievement in both mathematics and ELA.

The important question for this study is whether APP schools—after controlling for prior student achievement and pre-existing differences in school performance—perform differently from comparison schools *following* the installation of a new principal. In Table 6, this relationship is captured in the "APP * post new principal" interaction coefficient, which represents the *difference* in the "post new principal" effect between APP and comparison schools.

Here we find that in ELA average standardized scores in APP schools were marginally higher after the installation of the new principal, relative to comparison schools after the installation of a new principal. However, these estimates—which range from 0.012 to 0.019 standard deviations—are not statistically significant. Relative to the overall standard deviation across schools in average scores (about 0.45 to 0.48), all of these differences are also quite small. In mathematics, APP schools performed relatively worse than comparison schools in the years following the new

[32] See for example Boyd et al. (2008).

principal. Our estimate of the difference in the "post new principal" effect in mathematics ranges from -0.033 to -0.049 standard deviations. While this estimate is statistically significant in our models without controls, the estimate slips below statistical significance in our full model with controls (column (7)).

The results shown in Table 6 effectively consider two periods for these groups of schools: before the arrival of their new principal, and after. In Table 7, we estimate a more flexible model that allows for differential pre-and post- *trends* in school achievement. The structure of this table is identical to that of Table 6: columns (1) – (4) omit additional school level controls while (5) – (8) include them. Columns (3), (4), (7), and (8) represent models with fixed effects. All regressions control for lagged student achievement. As described above, "one year before new principal" is the baseline period for this analysis. "Two or more years before new principal," "first year new principal," "second year under new principal," and "third or later year under new principal" are all *differences with respect to the baseline year*. (The coefficient "APP school (one year before new principal)" contrasts APP schools with comparison schools in the baseline year, i.e. the year before the new principal). This model is also useful in that it allows us to see how average achievement changes with the accumulated experience of new principals.

*Table 7: Regression results for standardized mathematics and ELA scores, elementary and middle schools – pre and post trajectory model*

| | Basic Model | | | | Model with Controls | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA | (7) Math | (8) ELA |
| Prior year standardized score | 0.906*** | 0.896*** | 0.412*** | 0.376*** | 0.733*** | 0.703*** | 0.366*** | 0.323*** |
| | (0.034) | (0.035) | (0.055) | (0.053) | (0.076) | (0.073) | (0.055) | (0.047) |
| APP school (one year before new principal) | -0.026 | -0.092*** | -- | -- | -0.019 | -0.087*** | -- | -- |
| | (0.028) | (0.029) | | | (0.026) | (0.027) | | |
| 2nd or more years before new principal | 0.004 | -0.002 | 0.013 | 0.014 | 0.000 | -0.003 | 0.008 | 0.007 |
| | (0.015) | (0.015) | (0.013) | (0.012) | (0.015) | (0.013) | (0.013) | (0.011) |
| **APP * 2nd or more years before new principal** | **0.016** | **0.065*** | **-0.008** | **0.060*** | **0.010** | **0.058*** | **-0.002** | **0.058*** |
| | **(0.033)** | **(0.029)** | **(0.031)** | **(0.025)** | **(0.032)** | **(0.025)** | **(0.030)** | **(0.024)** |
| 1st year new principal | 0.029 | -0.054*** | 0.006 | -0.048*** | 0.017 | -0.042** | -0.008 | -0.038** |
| | (0.019) | (0.014) | (0.015) | (0.012) | (0.017) | (0.013) | (0.015) | (0.012) |
| **APP * 1st year new principal** | **-0.067** | **0.048** | **-0.056** | **0.047** | **-0.056** | **0.040** | **-0.045** | **0.049** |
| | **(0.040)** | **(0.034)** | **(0.034)** | **(0.027)** | **(0.039)** | **(0.032)** | **(0.034)** | **(0.025)** |
| 2nd year new principal | 0.036* | -0.010 | -0.001 | -0.022 | -0.009 | -0.030 | -0.035* | -0.012 |
| | (0.015) | (0.016) | (0.014) | (0.012) | (0.022) | (0.018) | (0.015) | (0.013) |
| **APP * 2nd year new principal** | **-0.021** | **0.031** | **-0.033** | **0.035** | **-0.019** | **0.030** | **-0.025** | **0.041** |
| | **(0.034)** | **(0.027)** | **(0.031)** | **(0.024)** | **(0.032)** | **(0.025)** | **(0.030)** | **(0.023)** |
| 3rd or later year new principal | 0.004 | -0.011 | -0.025* | -0.030* | -0.056 | -0.063* | -0.062*** | -0.031* |
| | (0.013) | (0.017) | (0.012) | (0.012) | (0.031) | (0.028) | (0.017) | (0.014) |
| **APP * 3rd or later year new principal** | **-0.035** | **0.065*** | **-0.043** | **0.057**** | **-0.034** | **0.057*** | **-0.032** | **0.059**** |
| | **(0.028)** | **(0.026)** | **(0.027)** | **(0.022)** | **(0.026)** | **(0.023)** | **(0.027)** | **(0.020)** |
| School fixed effects | NO | NO | YES | YES | NO | NO | YES | YES |
| Constant | -0.001 | -0.029 | -0.013 | -0.023** | 0.080 | 0.096 | 0.195 | 0.394** |
| | (0.014) | (0.016) | (0.010) | (0.008) | (0.065) | (0.062) | (0.162) | (0.146) |
| N | 1625 | 1623 | 1625 | 1623 | 1599 | 1597 | 1599 | 1597 |

Notes: see Appendix Table 3 for the full set of coefficient estimates from the model with controls. Regressions in columns (5) – (8) control for average student characteristics and per-pupil spending; columns (1), (2), (5), and (6) control for school level; (5) and (6) additionally control for borough effects. In columns (1), (2), (5), and (6) standard errors allow for clustering by school. Columns (3), (4), (7) and (8) are estimates from fixed effects models with robust standard errors in parentheses. * $p<0.05$, ** $p<0.01$, *** $p<0.001$. In all columns, one year before new principal is the omitted category.

With respect to mathematics achievement, the results in Table 7 roughly mirror those in Table 6. APP principals' schools perform marginally worse in mathematics during their first years on the job, relative to comparison schools, although these differences are statistically insignificant. This gap is visible in the "APP * 1st year new principal" coefficient. Importantly, this gap in the principal's first year is typically about twice as large as that estimated for later years (such as the "APP * 2nd year new principal" coefficient). This may suggest that mathematics performance in APP schools, relatively speaking, take an initial downturn in mathematics, relative to comparison schools, but then begin to rebound. However, none of these estimates are statistically significant.

Our findings for ELA are a bit more interesting and complex. Our descriptive look at trends in mean achievement presented in Section VI found that achievement in APP schools—particularly in ELA—was on a downward trajectory prior to their new principals' hiring. This pattern is visible here as well. In Table 7 we see that ELA performance *two or more* years before the new principal was *higher* than one year before (see the coefficient on "APP * 2nd or more years before new principal," which represents average achievement relative to the baseline year, one year before the new principal). In their first year as principal, comparison principals witnessed an average decline in standardized ELA scores. However, APP schools appear to have made offsetting improvements in ELA in their first year, relative to comparison schools. That is, APP schools did not experience the same "first year penalty" in ELA that the comparison schools did. In their second year, APP schools held steady, relative to comparison schools who had not yet recovered from their "first year penalty." Notably, by their third year, APP schools had risen to a level comparable to the baseline year while comparison schools continued to decline. These differences are statistically significant in the principals' third (and later) year.

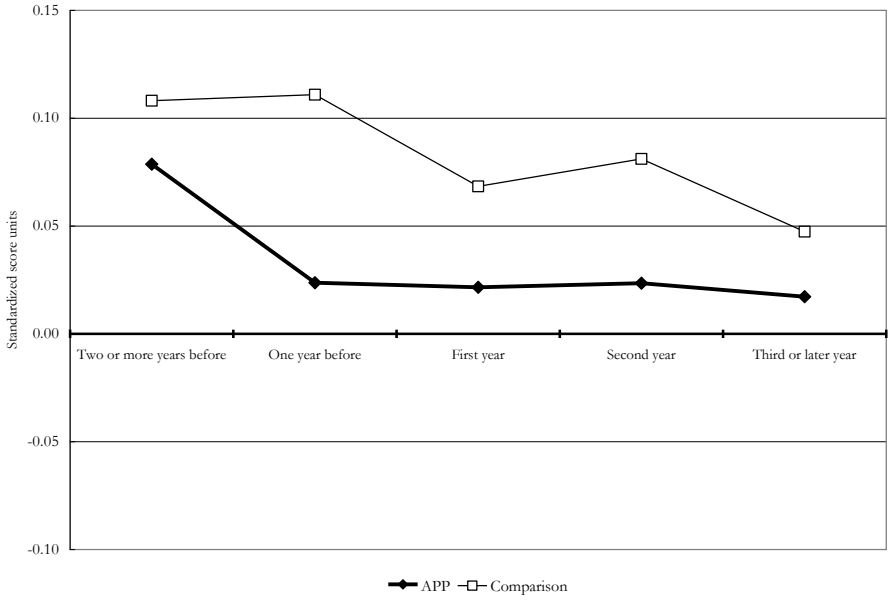
Taken together, the pattern of ELA results in Table 7 are easily reconciled with those in Table 6 which provided a more crude "before and after" comparison. There we found that new

APP principals' schools may have performed marginally better in ELA than comparison schools, but the differences were statistically insignificant. Table 7 illustrates why. In APP schools, the preceding years were characterized by ELA scores on a sharp downward trajectory. Scores modestly rebounded in the years following—relative to comparison principals—such that a "before and after" comparison shows only minor differences.

Figure 14 provides a visual summary of the ELA coefficients found in column (6) of Table 7 (the model with controls).[33] The points on these line graphs represent average school achievement in APP and comparison schools *after accounting for observable differences in schools via regression.* Average ELA achievement in APP schools fell below that of comparison schools in the years leading up to the new principal. Further, in the year just prior to the installation of the new principal, achievement in APP schools fell relative to that in comparison schools (which remained relatively constant). Then, while achievement fell in the first year of the comparison principals' tenure, achievement in APP schools remained stable. In the second and third years, APP schools held steady while standardized scores continued to fall in comparison schools.

[33] We do not provide this figure for math, as most of the coefficients in that model are statistically insignificant.

*Figure 14: Time pattern of ELA coefficients from Table 7 column (6)*




As described in the Methodological Appendix, we have also estimated a school-by-grade regression model, where each grade within a school is considered individually (with some accounting for common factors at the school level). While we do not have a theory for why new principals would have differing effects by grade, this model does improve somewhat on those presented in Tables 6-7 by making grade-specific comparisons. The results of this regression model can be found in Appendix Tables 5A and 5B. We find few differences using this approach.

## VIII. Regression Analysis: High Schools

In this section we use a similar approach to that taken in Section VII to formally compare outcomes in high schools led by APP and comparison principals. As stated before, because of the very small sample of APP high schools we are limited in our ability to learn much from a multiple regression analysis of these schools. In addition, because there are a large number of *new* high schools represented here (see Appendix Table 6), we are further constrained in our ability to make "before" and "after" comparisons of APP and comparison high schools.

With these limitations in mind, we begin by estimating a simple difference-in-difference model for Regents exam pass rates, similar to that in Table 6. We consider four Regents exams as our measures of high school student achievement: English, mathematics, biology, and global history. Passing is defined as a score of 55 and higher—the minimum requirement for a local diploma during this period—and a school's passing rate is defined as the fraction of students *who write the test* that pass with a score of 55 or higher. For high school students, we do not have a measure of lagged achievement as we did with elementary and middle school students. We do, however, control in our regressions for the same school characteristics used in Section VII (student race, free lunch eligibility, and the like). Because passing rates are influenced by the fraction of students who actually write the test in a given year, we also control for the percent of all students taking each exam.

Columns (1) – (4) of Table 8 represent the simple difference-in-difference regression model, while columns (5) – (8) represent the same model with district fixed effects (refer again to Section VII for an explanation of these models). *As before, only those schools with observed student outcomes before and after a new principal* contribute to the "APP * post new principal" estimate. Because there are many new schools among APP high schools, this constitutes only a small number of schools.

We find in Table 8 that—controlling for other school characteristics—APP schools performed as well, if not slightly better than comparison schools in the years leading up to the new principal transition. In global history, APP schools appear to have performed much better in these earlier years (9.6 percentage points, a statistically significant difference). This is visible in the "APP school (before new principal)" coefficient in Table 8. As was the case with elementary and middle schools, the first year with a new principal appears to have a small negative effect on student achievement in both APP and comparison schools, although English is the only subject for which this effect is statistically significant. (This is read from the "post new principal" coefficient in Table 8).

*Table 8: Regression results for high school Regents exam pass rates*

| | (1) Math Regents | (2) English Regents | (3) Biology Regents | (4) History Regents | (5) Math Regents | (6) English Regents | (7) Biology Regents | (8) History Regents |
|---|---|---|---|---|---|---|---|---|
| Percent taking | 0.036 | 0.058 | 0.057 | 0.022 | -0.020 | 0.022 | 0.000 | -0.023 |
| | (0.023) | (0.030) | (0.033) | (0.028) | (0.022) | (0.029) | (0.023) | (0.028) |
| APP school | 0.047 | 0.024 | 0.043 | 0.096** | | | | |
| | (0.026) | (0.024) | (0.046) | (0.034) | | | | |
| Post new principal | -0.019 | -0.082*** | -0.031 | -0.040 | -0.007 | -0.071** | -0.031 | -0.039 |
| | (0.020) | (0.021) | (0.040) | (0.028) | (0.023) | (0.025) | (0.024) | (0.029) |
| **APP * post new principal** | **-0.089**** | **-0.046** | **-0.057** | **-0.100**** | **-0.072*** | **-0.048** | **-0.030** | **-0.095*** |
| | **(0.030)** | **(0.028)** | **(0.044)** | **(0.033)** | **(0.034)** | **(0.037)** | **(0.036)** | **(0.042)** |
| Percent black | -0.049 | -0.129 | -0.159* | -0.032 | -0.503 | -0.297 | -0.198 | -0.523 |
| | (0.079) | (0.087) | (0.070) | (0.103) | (0.339) | (0.363) | (0.351) | (0.414) |
| Percent Hispanic | -0.021 | -0.066 | -0.095 | -0.003 | -0.865* | -0.511 | -0.380 | -0.414 |
| | (0.082) | (0.084) | (0.078) | (0.107) | (0.354) | (0.380) | (0.368) | (0.433) |
| Percent Asian or other | 0.194 | 0.170 | 0.433* | 0.588** | 0.870* | 0.737 | 0.145 | 1.120* |
| | (0.127) | (0.169) | (0.215) | (0.200) | (0.411) | (0.442) | (0.423) | (0.502) |
| Percent recent immigrant | 0.315** | 0.281* | 0.390** | 0.411* | 0.123 | 0.164 | 0.250 | 0.200 |
| | (0.113) | (0.123) | (0.145) | (0.158) | (0.254) | (0.271) | (0.260) | (0.309) |
| Percent female | 0.063 | 0.160* | 0.119 | 0.193 | 0.386 | -0.030 | -0.012 | 0.385 |
| | (0.048) | (0.067) | (0.088) | (0.105) | (0.210) | (0.227) | (0.217) | (0.256) |
| Percent eligible for free lunch | 0.027 | 0.037 | 0.020 | -0.002 | 0.036 | 0.022 | 0.029 | 0.005 |
| | (0.032) | (0.029) | (0.033) | (0.044) | (0.037) | (0.039) | (0.038) | (0.045) |
| Percent LEP | -0.357*** | -0.475*** | -0.588*** | -0.581*** | -0.090 | -0.281 | -0.313 | -0.257 |
| | (0.094) | (0.115) | (0.152) | (0.152) | (0.180) | (0.191) | (0.182) | (0.218) |
| Percent special education | 0.025 | -0.071 | -0.033 | 0.002 | 0.218** | 0.042 | 0.142* | 0.235** |
| | (0.050) | (0.057) | (0.056) | (0.064) | (0.067) | (0.071) | (0.066) | (0.083) |
| Constant | 0.876*** | 0.912*** | 0.885*** | 0.705*** | 1.194*** | 1.230*** | 1.104*** | 0.938* |
| | (0.081) | (0.100) | (0.082) | (0.117) | (0.319) | (0.342) | (0.330) | (0.388) |
| N | 538 | 537 | 538 | 538 | 538 | 537 | 538 | 538 |

Notes: clustered standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001. Due to the small number of observations, these models do not include borough effects (although models that do include borough effects are similar).

As before, the important question for this study is whether APP high schools—after controlling for other pre-existing differences in schools—perform differently from comparison schools following the installation of a new principal. In Table 8, this relationship is captured in the "APP * post new principal" interaction coefficient, which represents the *difference* in the "post new principal" effect between APP and comparison schools. We find that this differential is negative in all subjects, and statistically significant in both mathematics and history. This suggests that APP high schools may have performed relatively worse after the arrival of a new principal than similar comparison schools with new principals. However, as emphasized before, these estimates are generated from a very small number of schools for which data is available both before and after the new principal. In addition, we do not have a satisfactory measure of prior student achievement differences to rule out pre-existing differences academic achievement. As such, we cannot say with much confidence that these observed differences are attributable to school leadership.

Finally, in Table 9 we present results from a cross-sectional regression model that compares APP and comparison schools only in the "post new principal" years. In these models, we avoid the problem encountered in Table 8 from the large number of new schools. On the other hand, we introduce a potentially more serious problem of having no "before" observations to account for pre-existing differences in academic achievement. (Thus, these models make an even weaker case for a causal relationship between school leadership and outcomes). In this case, we continue to find a negative and statistically significant difference between APP and comparison schools on the Mathematics A Regents. APP schools also fell below comparison schools on the other three Regents exams, though these differences are statistically insignificant.

*Table 9: Regression results for high school Regents exam pass rates – cross-sectional model with "post new principal" years only*

| | (1) Math | (2) English | (3) Biology | (4) History |
|---|---|---|---|---|
| Percent taking | 0.210** | 0.063 | 0.124 | 0.111 |
| | (0.071) | (0.071) | (0.078) | (0.065) |
| APP school (post years only) | -0.042** | -0.020 | -0.013 | -0.007 |
| | (0.016) | (0.017) | (0.022) | (0.023) |
| Percent black | -0.040 | -0.108 | -0.123 | 0.067 |
| | (0.073) | (0.101) | (0.084) | (0.114) |
| Percent Hispanic | 0.017 | -0.064 | -0.039 | 0.070 |
| | (0.074) | (0.098) | (0.087) | (0.117) |
| Percent Asian or other | 0.095 | 0.180 | 0.458* | 0.618** |
| | (0.131) | (0.195) | (0.226) | (0.205) |
| Percent recent immigrant | 0.124 | 0.106 | 0.186 | 0.037 |
| | (0.104) | (0.142) | (0.225) | (0.224) |
| Percent female | 0.045 | 0.148* | 0.106 | 0.151 |
| | (0.047) | (0.070) | (0.088) | (0.108) |
| Percent free lunch | -0.039 | 0.004 | -0.023 | -0.060 |
| | (0.035) | (0.044) | (0.041) | (0.056) |
| Percent limited English proficient | -0.196* | -0.368** | -0.448** | -0.321 |
| | (0.086) | (0.126) | (0.160) | (0.176) |
| Perfect full-time special education | -0.165 | -0.343** | -0.213 | -0.330** |
| | (0.087) | (0.111) | (0.109) | (0.120) |
| Year effects | YES | YES | YES | YES |
| Constant | 0.755*** | 0.906*** | 0.782*** | 0.569*** |
| | (0.095) | (0.133) | (0.110) | (0.142) |
| N | 455 | 454 | 455 | 455 |

Notes: clustered standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001

## IX. Conclusion

The results of this analysis are encouraging, indicating that the NYC Leadership Academy has succeeded in bringing new principals to some of NYC's most challenging schools and curtailing their downward trends in performance, relative to the city. Although APP principals take charge of schools that had fallen behind other city schools, performance on standardized tests appear to have stabilized under their leadership and schools that had been falling relative to city-wide performance began to improve apace with city-wide growth. Further, there is some evidence that even more

improvement lies ahead. These results suggest the need for continued monitoring and follow-up study to understand whether—and to what extent—improvements in test scores persist and to identify the kinds of schools or conditions under which Aspiring Principal Program graduates are particularly successful (or unsuccessful). For the purpose of longitudinal analysis, this study was only able to focus on two cohorts of principals and aggregate school-level data, and examined performance over a relatively short period of time. Follow-up work using student-level data would allow us to understand the impact of Leadership Academy principals more fully and determine whether there are groups of students—such as initially low performing students—that are served particularly well.

## References


Boyd, Donald, Hamilton Lankford, Susanna Loeb, Jonah Rockoff, and James Wyckoff. 2008. "The Narrowing Gap in New York City Teacher Qualifications and Its Implications for Student Achievement in High-Poverty Schools." *Journal of Policy Analysis and Management* 27(4): 793-818.

Fullan, Michael and Suzanne M. Stiegelbauer. 1991. *The New Meaning of Educational Change*. New York: Teachers College Press.

Koretz, Daniel. 2008. *Measuring Up*. Cambridge: Harvard University Press.

Lankford, Hamilton, R.H. O'Connell, and James Wyckoff. 2003. *Our Next Generation: School Leadership in New York State*. Albany, NY: New York State Education Department [http://www.albany.edu/edfin/Our%20Next%20Generation.pdf]

Olsen, Lynn. 2007. "Academy in N.Y.C. Prepares Principals for Toughest Jobs." *Education Week*, December 5, 2007.

Papa Jr., Frank C., Hamilton Lankford, and James Wyckoff. 2002. "The Attributes and Career Paths of Principals: Implications for Improving Policy." Working Paper, University at Albany, SUNY [http://www.teacherpolicyresearch.org/portals/1/pdfs/Career_Paths_of_Principals.pdf]

## Methodological Appendix

In the following appendix, we outline our empirical approach to comparing academic outcomes in APP and comparison schools.

Empirical model

A contemporaneous comparison of APP and comparison schools (indexed with *i*) might be drawn by estimating the following regression model, for some school outcome variable *Y* (such as average mathematics performance):

$$(1) \qquad E[Y_{it} \mid APP_{it}, X_{it}] = \beta_0 + \beta_1 APP_{it} + \gamma X_{it}$$

This model assumes that average school outcomes in year *t* ($E[Y_{it}]$) can be expressed as a linear function of student and school characteristics $X_{it}$ (such as school poverty and the percent of students classified as ELLs) and an indicator of APP principal leadership $APP_{it}$ (which equals one if school *i* is led by an APP principal). If after controlling for observed student and school characteristics APP-led schools have superior outcomes, then $\beta_1$ should be positive.

A contemporaneous comparison falls far short of an ideal test for differences in school leadership, however. In most cases, the vector of observed school characteristics $X_{it}$ is unlikely to completely capture the myriad of ways in which APP and comparison schools differ with respect to outcomes. APP principals are new to their leadership roles, and are often placed in high-need schools with leadership vacancies. These vacancies may be indicative of poor past school performance or a generally challenging work environment. As a result, APP and comparison schools will typically differ in both observable and unobservable ways, even prior to their principals' arrival.

While this empirical challenge cannot be fully overcome here, we address the weaknesses of model (1) in several ways. First, we limit our analysis to schools led by principals with comparable tenure to our APP principals. In doing so, we avoid comparing schools led by APP principals to schools with experienced leadership that are likely to be more stable environments. Second, in most models we control for the *past* outcomes of students attending school *i* in year *t*:

$$(2) \qquad E[Y_{it} \mid APP_{it}, X_{it}, Y_{it-1}] = \beta_0 + \beta_1 APP_{it} + \phi Y_{it-1} + \gamma X_{it}$$

This model tests whether, after controlling for observed school characteristics $X_{it}$ and students past performance $Y_{it-1}$, APP-led schools have better outcomes than non-APP-led schools. ($Y_{it-1}$ represents the average outcomes of students attending school *i* in year *t* regardless of whether or not they attended *i* in year *t-1*). Third, we implement a difference-in-difference approach that compares APP school outcomes before and after the arrival of their APP principal to comparison school outcomes before and after the arrival of their new principal. Here, $Post_t$ is a variable that equals one in the years following the placement of a new principal, and $APP_i$ is an indicator of whether school *i* was eventually led by an APP principal:

$$(3) \qquad E[Y_{it} \mid APP_i, Post_t, X_{it}, Y_{it-1}] = \beta_0 + \beta_1 APP_i + \beta_2 Post_t + \beta_3 Post_t * APP_i + \phi Y_{it-1} + \gamma X_{it}$$

This is the empirical model estimated in columns (1), (2), (5), and (6) of Tables 6 and 7. This approach improves on models (1) and (2) by controlling for pre-existing outcomes in APP schools, allowing us to test whether APP schools experienced greater improvements after the installation of new leadership than similar comparison schools (this difference is captured by the coefficient $\beta_3$). Finally, we estimate model (3) with the addition of school fixed effects.[34] In this case, each school effectively has its own baseline level of achievement, and *changes* in outcomes within schools over time provide our estimate of the effect of APP leadership.

From an internal validity standpoint, the difference-in-difference model with school fixed effects is our preferred model. However, estimation of this model (as well as model (3)) relies on having observed outcomes for schools both before and after the arrival of a new principal. As seen in Appendix Table 1, there are many cases where school observations are not available prior to the new principal's arrival. This is especially true at the high school level, where new principals were more likely to be placed in a newly opened school with no prior history.

The usual assumption in econometric models is that the error term is identically and independently distributed. In models (1) – (3), however, we have repeated observations on schools over multiple years. Thus there is good reason to believe that the error term—representing explanatory factors not captured in the regressors—are correlated within schools over time. Because of this, we assume "clustered" errors within each school group *i*. This assumption presumes zero correlation across groups (schools) but leaves the correlation within groups unspecified. In model (3) with school fixed effects, we instead use Huber-White heteroskedasticity robust standard errors.

As an alternative model, we also estimate a school-by-grade regression model, where each grade within a school is considered individually. That is, each data point used in the regression is a school (*i*) * grade (*j*) combination:

$$(4) \quad E[Y_{ijt} \mid APP_i, Post_t, X_{ijt}, Y_{ijt-1}] = \beta_0 + \beta_1 APP_i + \beta_2 Post_t + \beta_3 Post_t * APP_i + \phi Y_{ijt-1} + \gamma X_{ijt} + \kappa_j$$

While we do not have a theory for why new principals would have differing effects by grade, this model does improve somewhat on (3) by making grade-specific comparisons. The outcomes (*Y*) of students in grade *j* are better matched with those students past performance and observable characteristics (*X*). School-by-grade models also allow us to include a grade-specific fixed effect $\kappa_j$ that accounts for differential initial levels of achievement by grade. Finally, model (4) allows for further interaction between *Post, APP,* and grade *j*. Estimates of model (4) are provided in Appendix Tables 5A (with interaction effects) and 5B (without interaction effects).

Internal validity

Ideally, one would assess the relative effectiveness of APP-prepared principals by randomly assigning APP and other new, non-APP principals to schools, and then testing for differences in outcomes at a later date. Unfortunately for purposes of evaluation, principals are never assigned in this way.

[34] In practice this implies the use of a set of dummy variables for each individual school.

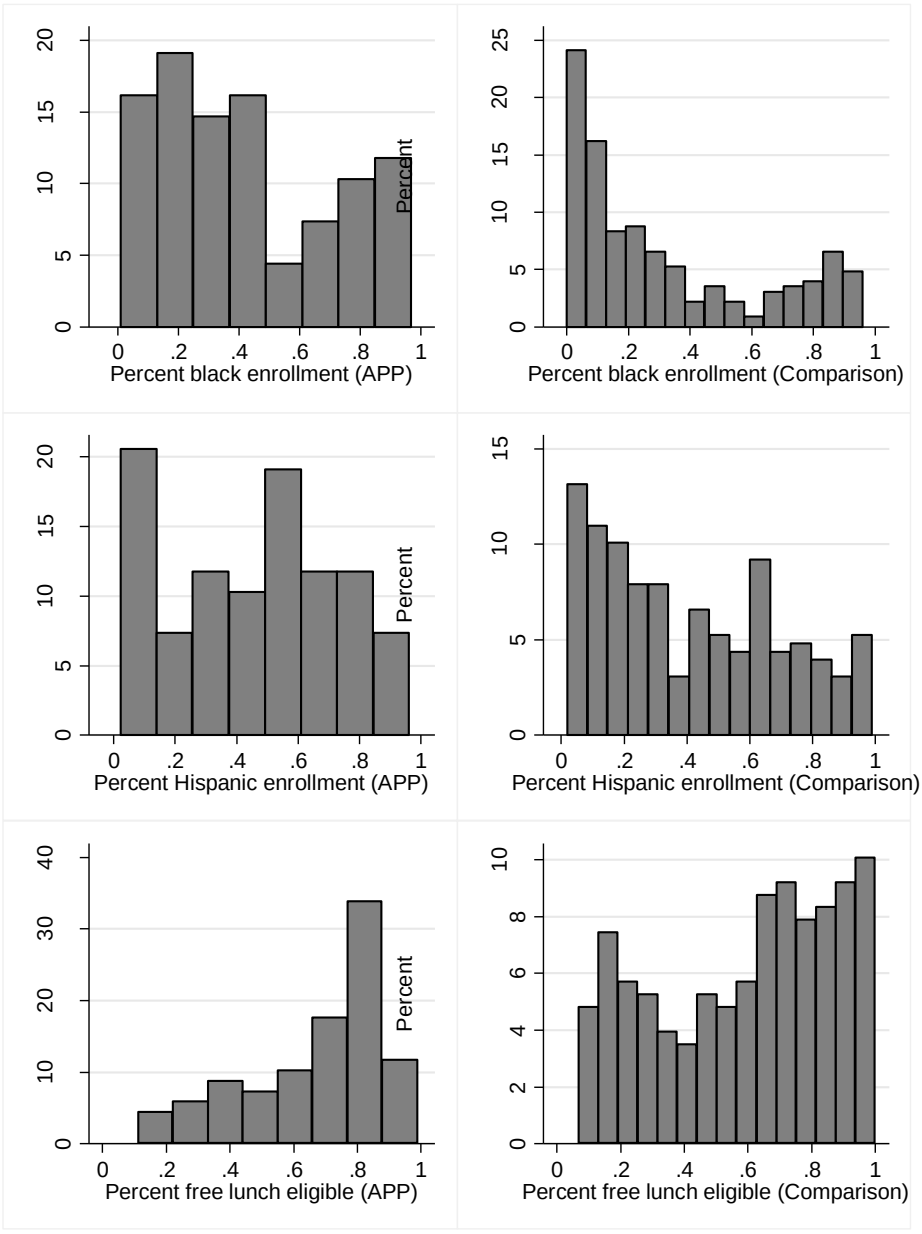
On the contrary, APP and comparison principals were assigned to schools in ways that were anything but random. Many non-APP principals, for example, rose to the rank of principal in a school where they had taught for many years. APP principals, on the other hand, were often purposefully placed in high-need schools where a vacancy existed. (Such vacancies, of course, are also non-random). This targeting is explicitly part of the mission of the NYC Leadership Academy. As a result, APP and comparison schools differed substantially on observable and unobservable dimensions well before these principals assumed leadership.

Due to this non-random assignment process, our research design necessarily lacks the internal validity of a randomized controlled experiment. While we make every attempt in our analysis to account for systematic, pre-existing differences between schools, we can never be fully certain that observed difference in outcomes between APP and comparison schools are solely attributable to differences in leadership training.

External validity

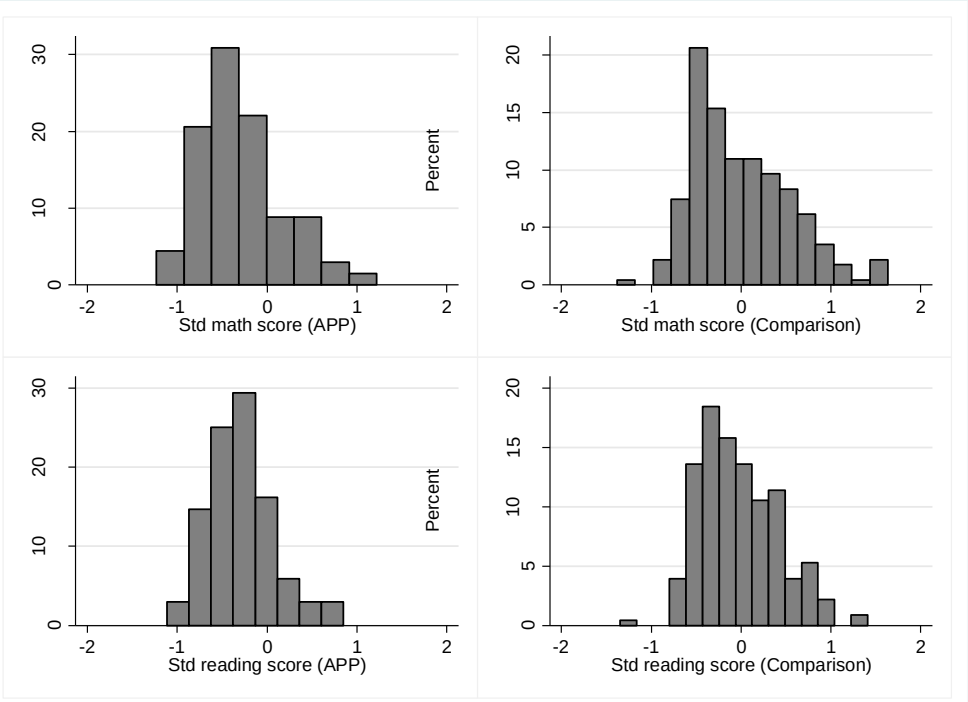
We also emphasize that principals who enroll in (and complete) the Aspiring Principals Program are not a random sample of potential New York City principals. Candidates choose to apply, and the NYC Leadership Academy selects those they believe will be most successful in a school leadership position. In this setting, random assignment of principals to schools could tell us something about the overall effectiveness of Leadership Academy selected and trained candidates. But even under random assignment, we would not be able to provide a clear picture of the effectiveness of APP training for the *average principal candidate*.

Appendix Figure 1: Initial year distribution of average student characteristics, APP and comparison schools serving elementary and middle grades



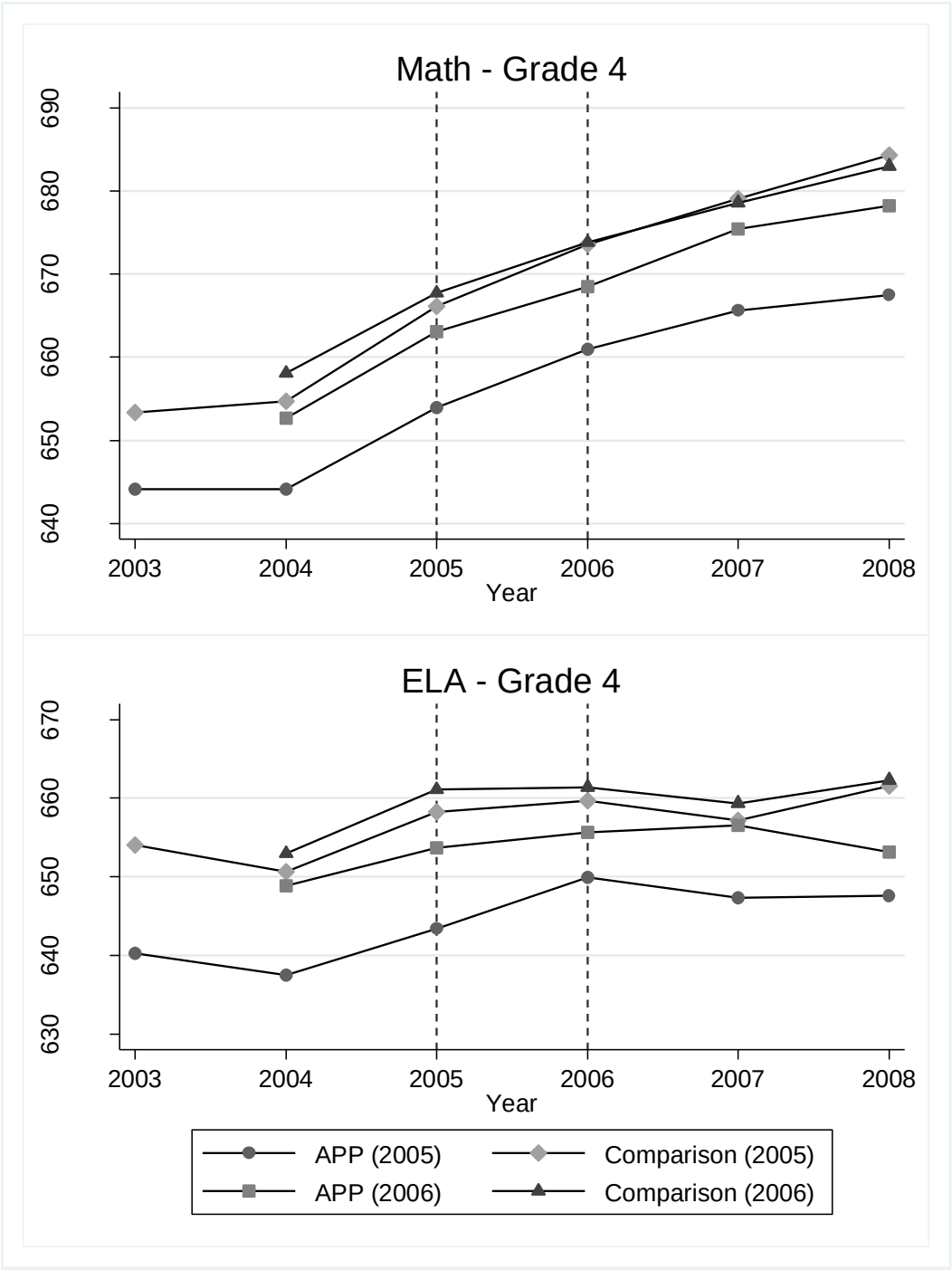

Notes: elementary and middle school subsample, N=296 (68 APP and 228 comparison principals, in their first year as principal (2005 or 2006)).

Appendix Figure 2: Initial year distribution of average mathematics and ELA achievement, APP and comparison schools serving elementary and middle grades




Notes: elementary and middle school subsample, N=296 (68 APP and 228 comparison principals). Scores reflect the average for the school in the principal's first year.

Appendix Figure 3: Average grade 4 scale scores in mathematics and ELA, constant cohorts of APP and comparison schools, 2003 - 2008




Notes: see notes to Figure 10.

Appendix Table 1: Mean characteristics of APP and comparison principals in 2007-08, split elementary/middle and high school samples

| | Elementary/middle | | | | High school | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | | | | Mean | | | |
| | APP | Comparison | *p* | | APP | Comparison | *p* | |
| Percent male | 27.9 | 22.4 | 0.012 | ** | 52.4 | 47.6 | 0.690 | |
| Percent white | 48.5 | 50.4 | 0.564 | | 38.1 | 47.6 | 0.424 | |
| Percent black | 38.2 | 29.4 | 0.002 | ** | 42.9 | 31.4 | 0.311 | |
| Percent Hispanic | 11.8 | 17.1 | 0.018 | * | 14.3 | 15.2 | 0.911 | |
| Percent Asian | 1.5 | 1.8 | 0.969 | | 0.0 | 3.8 | 0.363 | |
| Percent American Indian | 0.0 | 0.9 | 0.067 | | 4.8 | 1.9 | 0.433 | |
| | | | | | | | | |
| Age | 44.7 | 48.8 | <0.001 | *** | 44.4 | 46.8 | 0.172 | |
| Years at this school | 3.6 | 6.1 | <0.001 | *** | 4.0 | 5.1 | 0.005 | ** |
| Years taught at this school | 0.1 | 1.1 | <0.001 | *** | 0.2 | 0.4 | 0.509 | |
| Years asst principal at this school | 0.0 | 1.2 | <0.001 | *** | 0.0 | 0.6 | <0.001 | *** |
| Years principal at this school | 3.6 | 3.7 | 0.013 | * | 3.8 | 3.9 | 0.470 | |
| Total years taught | 7.1 | 10.7 | <0.001 | *** | 7.7 | 9.4 | 0.269 | |
| Total years asst principal | 0.4 | 3.3 | <0.001 | *** | 0.2 | 2.8 | <0.001 | *** |
| Total years as principal | 3.7 | 3.8 | 0.833 | | 3.8 | 3.9 | 0.382 | |

Notes: separate calculations for elementary/middle and high school subsamples. See Tables 4-5 for sample sizes. *p* value is from a *t*-test for a difference in means. *** indicates statistically significant difference at the 0.01 level; ** indicates statistically significant difference at the 0.05 level; * indicates statistically significant difference at the 0.01 level.

Appendix Table 2: Principal cohorts and years of available pre- and post- data

| Years of data observed | | Elementary/Middle | | High school | |
|---|---|---|---|---|---|
| | | APP | Comparison | APP | Comparison |
| **First year as principal was 2004-05:** | | **38** | **114** | **13** | **66** |
| Pre: 2002-03 and 2003-04 | Post: 2004-05 through 2007-08 | 27 | 90 | | |
| Pre: 2003-04 | Post: 2004-05 through 2007-08 | | 4 | 8 | 30 |
| Pre: none | Post: 2004-05 through 2007-08 | 10 | 18 | 4 | 35 |
| Pre: none | Post: 2005-06 through 2007-08 | | 2 | 1 | |
| Pre: 2003-04 | Post: 2004-05 only | | | | 1 |
| **First year as principal was 2005-06:** | | **31** | **116** | **9** | **39** |
| Pre: 2002-03 through 2004-05 | Post: 2005-06 through 2007-08 | 19 | 95 | | |
| Pre: 2004-05 | Post: 2005-06 through 2007-08 | 3 | 7 | 5 | 24 |
| Pre: 2003-04 and 2004-05 | Post: 2005-06 through 2007-08 | | | 4 | 15 |
| Pre: 2002-03 through 2004-05 | Post: 2005-06 | | 1 | | |
| Pre: none | Post: 2005-06 through 2007-08 | 9 | 13 | | |
| **Total** | | **69** | **230** | **22** | **105** |

Appendix Table 3: Full regression results—model with controls, elementary and middle schools

| | Basic Model with Controls | | | | Pre- and Post-Trajectory Model with Controls | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA | (7) Math | (8) ELA |
| Prior year standardized score | 0.739*** (0.075) | 0.706*** (0.071) | 0.367*** (0.056) | 0.323*** (0.047) | 0.733*** (0.076) | 0.703*** (0.073) | 0.366*** (0.055) | 0.323*** (0.047) |
| APP school (one year before new principal) | -0.013 (0.018) | -0.054** (0.020) | - | - | -0.019 (0.026) | -0.087*** (0.027) | - | - |
| Post new principal | -0.008 (0.017) | -0.043*** (0.011) | -0.028** (0.010) | -0.034*** (0.008) | | | | |
| **APP * post new principal** | **-0.042* (0.018)** | **0.012 (0.017)** | **-0.033 (0.018)** | **0.019 (0.015)** | | | | |
| 2nd or more years before new principal | | | | | 0.000 (0.015) | -0.003 (0.013) | 0.008 (0.013) | 0.007 (0.011) |
| **APP * 2nd or more years before new principal** | | | | | **0.010 (0.032)** | **0.058* (0.025)** | **-0.002 (0.030)** | **0.058* (0.024)** |
| 1st year new principal | | | | | 0.017 (0.017) | -0.042** (0.013) | -0.008 (0.015) | -0.038** (0.012) |
| **APP * 1st year new principal** | | | | | **-0.056 (0.039)** | **0.040 (0.032)** | **-0.045 (0.034)** | **0.049 (0.025)** |
| 2nd year new principal | | | | | -0.009 (0.022) | -0.030 (0.018) | -0.035* (0.015) | -0.012 (0.013) |
| **APP * 2nd year new principal** | | | | | **-0.019 (0.032)** | **0.030 (0.025)** | **-0.025 (0.030)** | **0.041 (0.023)** |
| 3rd or later year new principal | | | | | -0.056 (0.031) | -0.063* (0.028) | -0.062*** (0.017) | -0.031* (0.014) |
| **APP * 3rd or later year new principal** | | | | | **-0.034 (0.026)** | **0.057* (0.023)** | **-0.032 (0.027)** | **0.059** (0.020)** |
| Percent black | -0.003*** (0.001) | -0.003*** (0.001) | -0.006** (0.002) | -0.006*** (0.002) | -0.003*** (0.001) | -0.003*** (0.001) | -0.006** (0.002) | -0.006*** (0.002) |
| Percent Hispanic | -0.002* (0.001) | -0.002** (0.001) | -0.004* (0.002) | -0.006*** (0.002) | -0.002** (0.001) | -0.002** (0.001) | -0.004* (0.002) | -0.006*** (0.002) |

| | Basic Model with Controls | | | | Pre- and Post-Trajectory Model with Controls | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA | (7) Math | (8) ELA |
| Percent Asian or other | 0.002** | 0.000 | 0.005* | -0.001 | 0.002** | 0.000 | 0.006* | -0.001 |
| | (0.001) | (0.000) | (0.002) | (0.002) | (0.001) | (0.000) | (0.002) | (0.002) |
| Percent recent immigrant | -0.006** | -0.002 | -0.007*** | 0.002 | -0.008** | -0.002 | -0.009*** | 0.003 |
| | (0.002) | (0.001) | (0.002) | (0.002) | (0.003) | (0.002) | (0.002) | (0.002) |
| Percent female | 0.002* | 0.003** | 0.001 | 0.003* | 0.001 | 0.003** | 0.001 | 0.003* |
| | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) |
| Percent eligible for free lunch | -0.000 | -0.001* | 0.000 | 0.000 | -0.000 | -0.001* | 0.000 | -0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Percent LEP | -0.001 | -0.004*** | -0.004** | -0.009*** | -0.000 | -0.004*** | -0.003* | -0.010*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Percent special education | -0.001 | -0.006*** | 0.001 | -0.005*** | -0.004 | -0.007*** | -0.001 | -0.005*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.001) | (0.001) |
| Budget per student | 0.003 | -0.001 | 0.007*** | -0.000 | 0.003 | -0.001 | 0.007*** | -0.000 |
| | (0.002) | (0.001) | (0.001) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) |
| Borough = Bronx | 0.061 | 0.101** | | | 0.060 | 0.101** | | |
| | (0.036) | (0.038) | | | (0.036) | (0.038) | | |
| Borough = Brooklyn | 0.065* | 0.067* | | | 0.065* | 0.066* | | |
| | (0.026) | (0.028) | | | (0.026) | (0.028) | | |
| Borough = Manhattan | 0.040 | 0.088** | | | 0.044 | 0.089** | | |
| | (0.025) | (0.031) | | | (0.026) | (0.032) | | |
| Borough = Queens | 0.088* | 0.087** | | | 0.088* | 0.087** | | |
| | (0.035) | (0.032) | | | (0.035) | (0.033) | | |
| School fixed effects | NO | NO | YES | YES | NO | NO | YES | YES |
| School level effects | YES | YES | NO | NO | YES | YES | NO | NO |
| Constant | 0.057 | 0.092 | 0.199 | 0.413** | 0.106 | 0.111 | 0.225 | 0.411** |
| | (0.058) | (0.053) | (0.159) | (0.147) | (0.068) | (0.067) | (0.165) | (0.148) |
| N | 1599 | 1597 | 1599 | 1597 | 1599 | 1597 | 1599 | 1597 |

Notes: these are the complete results corresponding to columns (5) – (8) of Table 6 and 7. Standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001

Appendix Table 4: Full regression results, elementary and middle school-by-grade models (with no additional controls)

| | Basic Model with Controls | | | | Pre- and Post Trajectory Model with Controls | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA | (7) Math | (8) ELA |
| Lagged standardized score | 0.971*** (0.008) | 0.839*** (0.032) | 0.660*** (0.023) | 0.221*** (0.060) | 0.971*** (0.008) | 0.847*** (0.031) | 0.650*** (0.022) | 0.245*** (0.061) |
| APP school | -0.007 (0.017) | -0.058* (0.026) | | | 0.001 (0.031) | -0.057 (0.030) | | |
| Post new principal | 0.012 (0.009) | -0.048*** (0.012) | -0.012 (0.010) | -0.051*** (0.010) | | | | |
| **APP * post new principal** | **-0.014 (0.020)** | **0.003 (0.022)** | **-0.017 (0.022)** | **-0.014 (0.020)** | | | | |
| Two or more years before new principal | | | | | -0.058*** (0.016) | 0.133*** (0.021) | -0.055** (0.019) | 0.095*** (0.017) |
| APP * two or more years before new principal | | | | | -0.013 (0.035) | -0.001 (0.032) | -0.013 (0.043) | 0.012 (0.038) |
| First year new principal | | | | | 0.042 (0.025) | -0.044* (0.021) | 0.026 (0.023) | -0.035 (0.020) |
| **APP * first year new principal** | | | | | **-0.048 (0.050)** | **0.010 (0.039)** | **-0.043 (0.052)** | **-0.002 (0.043)** |
| 2nd or later year for new principal | | | | | -0.049*** (0.014) | 0.060*** (0.013) | -0.077*** (0.017) | 0.020 (0.015) |
| **APP * 2nd or later year for new principal** | | | | | **-0.011 (0.032)** | **-0.000 (0.028)** | **-0.017 (0.038)** | **-0.008 (0.033)** |
| Grade = 5 | -0.074*** (0.014) | 0.151*** (0.012) | -0.060*** (0.008) | 0.085*** (0.010) | -0.075*** (0.014) | 0.153*** (0.012) | -0.061*** (0.008) | 0.089*** (0.010) |
| Grade = 6 | -0.027* (0.012) | 0.117*** (0.013) | 0.080*** (0.012) | 0.154*** (0.012) | -0.028* (0.012) | 0.119*** (0.013) | 0.080*** (0.013) | 0.156*** (0.012) |
| Grade = 7 | 0.001 (0.010) | 0.121*** (0.014) | 0.122*** (0.014) | 0.160*** (0.013) | 0.001 (0.010) | 0.121*** (0.014) | 0.123*** (0.014) | 0.161*** (0.013) |
| Grade = 8 | 0.100*** (0.011) | 0.087*** (0.019) | 0.249*** (0.020) | 0.101*** (0.018) | 0.100*** (0.011) | 0.091*** (0.019) | 0.252*** (0.019) | 0.105*** (0.017) |
| School fixed effects | NO | NO | YES | YES | NO | NO | YES | YES |

| | Basic Model with Controls | | | | Pre- and Post Trajectory Model with Controls | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA | (7) Math | (8) ELA |
| Constant | -0.001 | -0.089*** | -0.062*** | -0.104*** | 0.034* | -0.168*** | -0.027 | -0.163*** |
| | (0.010) | (0.014) | (0.011) | (0.012) | (0.016) | (0.015) | (0.017) | (0.015) |
| N | 4293 | 4270 | 4293 | 4270 | 4293 | 4270 | 4293 | 4270 |

Notes: in columns (1), (2), (5), and (6) standard errors allow for clustering by school. Columns (3), (4), (7) and (8) are estimates from fixed effects models with robust standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001. In columns (5) – (8), two or more years before new principal is the omitted category.

Appendix Table 5A: Full regression results, elementary and middle school-by-grade models (with controls and grade interactions)

| | No interactions | | No interactions | | Including interactions | |
|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA |
| Lagged standardized score | 0.845*** (0.017) | 0.524*** (0.058) | 0.626*** (0.022) | 0.181*** (0.054) | 0.635*** (0.022) | 0.169** (0.056) |
| APP school | -0.007 (0.017) | -0.055* (0.026) | | | | |
| Post new principal | 0.014 (0.011) | -0.085*** (0.012) | 0.007 (0.011) | -0.063*** (0.010) | 0.070*** (0.014) | -0.047*** (0.013) |
| **APP * post new principal** | **-0.011 (0.020)** | **0.012 (0.022)** | **-0.015 (0.021)** | **-0.009 (0.019)** | **0.019 (0.026)** | **0.029 (0.028)** |
| Percent black | -0.002*** (0.000) | -0.005*** (0.001) | -0.004** (0.001) | -0.010*** (0.002) | -0.003* (0.001) | -0.010*** (0.002) |
| Percent Hispanic | -0.001** (0.000) | -0.005*** (0.001) | -0.002 (0.001) | -0.008*** (0.002) | -0.002 (0.001) | -0.008*** (0.002) |
| Percent Asian or other | 0.000 (0.000) | 0.000 (0.001) | 0.001 (0.002) | -0.002 (0.002) | 0.001 (0.002) | -0.001 (0.002) |
| Percent recent immigrant | 0.002 (0.001) | -0.010*** (0.002) | 0.007*** (0.002) | -0.008*** (0.002) | 0.007*** (0.002) | -0.008*** (0.002) |
| Percent female | 0.002*** (0.001) | 0.004*** (0.001) | 0.002* (0.001) | 0.003*** (0.001) | 0.001 (0.001) | 0.003*** (0.001) |
| Percent eligible for free lunch | -0.000 (0.000) | -0.001** (0.000) | 0.000 (0.000) | -0.000 (0.000) | 0.000 (0.000) | -0.000 (0.000) |
| Percent LEP | -0.004*** (0.001) | -0.004** (0.001) | -0.006*** (0.001) | -0.008*** (0.001) | -0.007*** (0.001) | -0.008*** (0.001) |
| Percent special education | 0.002* (0.001) | -0.009*** (0.001) | 0.003*** (0.001) | -0.005*** (0.001) | 0.002** (0.001) | -0.005*** (0.001) |
| Borough = Bronx | 0.048 (0.025) | 0.155*** (0.044) | | | | |
| Borough = Brooklyn | 0.070** (0.023) | 0.148*** (0.043) | | | | |
| Borough = Manhattan | 0.072** (0.023) | 0.193*** (0.046) | | | | |
| Borough = Queens | 0.073** (0.024) | 0.170*** (0.044) | | | | |
| Grade = 5 | -0.074*** (0.013) | 0.111*** (0.012) | -0.065*** (0.008) | 0.073*** (0.010) | -0.016 (0.014) | 0.069*** (0.013) |
| Grade = 6 | -0.032** (0.012) | 0.093*** (0.012) | 0.069*** (0.013) | 0.133*** (0.012) | 0.091*** (0.018) | 0.143*** (0.016) |
| Grade = 7 | -0.006 (0.011) | 0.088*** (0.013) | 0.109*** (0.014) | 0.138*** (0.013) | 0.153*** (0.019) | 0.167*** (0.018) |
| Grade = 8 | 0.102*** (0.011) | 0.032* (0.014) | 0.236*** (0.019) | 0.069*** (0.018) | 0.314*** (0.038) | 0.045 (0.041) |

| | No interactions | | No interactions | | Including interactions | |
|---|---|---|---|---|---|---|
| | (1) Math | (2) ELA | (3) Math | (4) ELA | (5) Math | (6) ELA |
| APP school * grade 5 | | | | | 0.009 | 0.034 |
| | | | | | (0.031) | (0.030) |
| APP school * grade 6 | | | | | 0.016 | 0.048 |
| | | | | | (0.040) | (0.035) |
| APP school * grade 7 | | | | | -0.017 | 0.065 |
| | | | | | (0.041) | (0.037) |
| APP school * grade 8 | | | | | -0.003 | 0.069 |
| | | | | | (0.074) | (0.074) |
| Post new principal * grade 5 | | | | | -0.079*** | -0.004 |
| | | | | | (0.018) | (0.018) |
| Post new principal * grade 6 | | | | | -0.038* | -0.034 |
| | | | | | (0.019) | (0.018) |
| Post new principal * grade 7 | | | | | -0.065*** | -0.058** |
| | | | | | (0.019) | (0.019) |
| Post new principal * grade 8 | | | | | -0.130** | 0.021 |
| | | | | | (0.045) | (0.045) |
| APP * post * grade 5 | | | | | -0.065 | -0.010 |
| | | | | | (0.042) | (0.038) |
| APP * post * grade 6 | | | | | -0.042 | -0.015 |
| | | | | | (0.039) | (0.036) |
| APP * post * grade 7 | | | | | -0.020 | -0.071 |
| | | | | | (0.034) | (0.037) |
| APP * post * grade 8 | | | | | -0.014 | -0.060 |
| | | | | | (0.084) | (0.082) |
| School fixed effects | NO | NO | YES | YES | YES | YES |
| Constant | -0.051 | 0.153* | 0.066 | 0.579*** | 0.010 | 0.566*** |
| | (0.042) | (0.073) | (0.124) | (0.165) | (0.127) | (0.165) |
| N | 4293 | 4270 | 4293 | 4270 | 4293 | 4270 |

Appendix Table 5B: Full regression results, elementary and middle school-by-grade models (with controls and no grade interactions)

| | (1) Math | (2) ELA | (3) Math | (4) ELA |
|---|---|---|---|---|
| Lagged standardized score | 0.830*** | 0.538*** | 0.612*** | 0.197*** |
| | (0.016) | (0.058) | (0.022) | (0.054) |
| APP school | 0.003 | -0.053 | | |
| | (0.028) | (0.032) | | |
| Two or more years before new principal | -0.057*** | 0.107*** | -0.055** | 0.080*** |
| | (0.015) | (0.016) | (0.018) | (0.017) |
| **APP * two or more years before new principal** | **-0.016** | **-0.004** | **-0.009** | **0.019** |
| | **(0.035)** | **(0.028)** | **(0.042)** | **(0.038)** |
| First year new principal | 0.035 | -0.038* | 0.025 | -0.033 |
| | (0.025) | (0.019) | (0.023) | (0.020) |
| **APP * first year new principal** | **-0.048** | **0.006** | **-0.041** | **0.000** |
| | **(0.051)** | **(0.040)** | **(0.051)** | **(0.043)** |
| 2nd or later year for new principal | -0.067*** | -0.009 | -0.079*** | -0.003 |
| | (0.015) | (0.012) | (0.017) | (0.015) |
| **APP * 2nd or later year for new principal** | **-0.011** | **0.012** | **-0.012** | **0.005** |
| | **(0.030)** | **(0.027)** | **(0.037)** | **(0.033)** |
| Percent black | -0.002*** | -0.005*** | -0.004** | -0.009*** |
| | (0.000) | (0.001) | (0.001) | (0.002) |
| Percent Hispanic | -0.001*** | -0.005*** | -0.003* | -0.007*** |
| | (0.000) | (0.001) | (0.001) | (0.002) |
| Percent Asian or other | 0.001 | 0.000 | 0.001 | -0.001 |
| | (0.000) | (0.001) | (0.002) | (0.002) |
| Percent recent immigrant | -0.001 | -0.008*** | 0.003 | -0.006*** |
| | (0.001) | (0.002) | (0.002) | (0.002) |
| Percent female | 0.002*** | 0.004*** | 0.002* | 0.003*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Percent eligible for free lunch | -0.000 | -0.001** | 0.000 | -0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Percent LEP | -0.003*** | -0.005** | -0.005*** | -0.008*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Percent special education | -0.002* | -0.007*** | -0.001 | -0.004*** |
| | (0.001) | (0.001) | (0.001) | (0.001) |
| Borough = Bronx | 0.043 | 0.154*** | | |
| | (0.023) | (0.042) | | |
| Borough = Brooklyn | 0.070** | 0.145*** | | |
| | (0.022) | (0.040) | | |
| Borough = Manhattan | 0.074*** | 0.189*** | | |
| | (0.022) | (0.044) | | |
| Borough = Queens | 0.076*** | 0.164*** | | |
| | (0.022) | (0.042) | | |
| Grade = 5 | -0.073*** | 0.113*** | -0.064*** | 0.075*** |
| | (0.013) | (0.012) | (0.008) | (0.010) |

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Math | ELA | Math | ELA |
| Grade = 6 | -0.031** | 0.093*** | 0.071*** | 0.134*** |
| | (0.012) | (0.012) | (0.013) | (0.012) |
| Grade = 7 | -0.005 | 0.088*** | 0.113*** | 0.138*** |
| | (0.011) | (0.013) | (0.014) | (0.014) |
| Grade = 8 | 0.104*** | 0.035* | 0.241*** | 0.071*** |
| | (0.011) | (0.014) | (0.019) | (0.018) |
| School effects | NO | NO | YES | YES |
| Constant | 0.038 | 0.073 | 0.156 | 0.476** |
| | (0.040) | (0.070) | (0.123) | (0.166) |
| N | 4293 | 4270 | 4293 | 4270 |

Appendix Table 6: APP high schools included in the study

| LCMS | School | BDS | Year opened |
|---|---|---|---|
| | **APP 2005 Cohort (12)** | | |
| K477 | Samuel Tilden H.S. | 318477 | 1930 |
| K524 | International High School at Prospect Heights | 317524 | 2005 |
| K533 | School for Democracy and Leadership | 317533 | 2005 |
| K537 | High School for Youth and Community Development at Erasmus | 373537 | 2005 |
| M492 | High School for Law, Advocacy, and Community Justice | 103492 | 2003 |
| M685 | Bread and Roses Integrated Arts High School | 105685 | 1998 |
| M690 | School for the Physical City | 179690 | 1994 |
| M695 | Urban Peace Academy | 179695 | 1994 |
| X239 | The Urban Assembly Academy for History and Citizenship for Young Men | 209239 | 2005 |
| X437 | Fordham High School for the Arts | 210437 | 2003 |
| X500 | Hostos-Lincoln Academy of Science | 207500 | 2005 |
| X543 | High School for Violin and Dance[35] | 212543 | 2003 |
| | **APP 2006 Cohort (9)** | | |
| K350 | The Urban Assembly School of Music and Art | 313350 | 2006 |
| M299 | High School for Arts, Imagination, and Inquiry | 103299 | 2006 |
| M408 | Professional Performing Arts High School | 102408 | 1991 |
| M495 | Park East High School | 104495 | 2003 |
| M555 | Central Park East Secondary High School | 104555 | 1985 |
| M635 | Academy of Environmental Science Secondary High School | 104635 | 2001 |
| Q248 | Queens Preparatory Academy | 429248 | 2006 |
| Q259 | Pathways College Preparatory School: A College Board School | 429259 | 2006 |
| X321 | Crotona Academy High School | 279321 | 2005 |

Notes: "year" refers to Spring of the academic year.

[35] Part of the Morris High School restructuring

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