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ABSTRACT

Charter schools affiliated with the Knowledge is Power Program (KIPP) are emblematic of the No Excuses approach to public education. These schools feature a long school day, an extended school year, selective teacher hiring, strict behavior norms and a focus on traditional reading and math skills. We use applicant lotteries to evaluate the impact of KIPP Academy Lynn, a KIPP charter school that is mostly Hispanic and has a high concentration of limited English proficiency (LEP) and special-need students, groups that charter critics have argued are typically under-served. The results show overall gains of 0.35 standard deviations in math and 0.12 standard deviations in reading for each year spent at KIPP Lynn. LEP students, special education students, and those with low baseline scores benefit more from time spent at KIPP than do other students, with reading gains coming almost entirely from the LEP group.

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I. Introduction

Charter schools are publicly funded but operate with almost as much autonomy as private schools. The questions of whether charter schools improve academic achievement and which students benefit most from charter attendance remain controversial among both researchers and policymakers. Recent quasi-experimental evaluations in Boston (Abdulkadiroğlu, Angrist, Dynarski, Kane, and Pathak 2009) and New York City (Hoxby and Murarka 2009, Dobbie and Fryer 2009) suggest some charter schools produce large test score gains, at least for some students.

The nation's largest charter management organization is the Knowledge is Power Program (KIPP), with 80 schools operating or slated to open soon. KIPP schools target low-income and minority students and subscribe to an approach some have called "No Excuses" (Carter 2000; Thernstrom and Thernstrom 2003). No Excuses schools focus on traditional math and reading skills and feature a long school day and year, selective teacher hiring, strict behavior norms, and a strong student work ethic. KIPP schools have been central in the debate over whether schools alone can substantially reduce racial achievement gaps. Descriptive accounts suggest KIPP is producing substantial score gains (see, e.g., Mathews 2009), but critics argue that the apparent KIPP advantage is driven by underlying differences between those who attend KIPP and students who remain in traditional public schools (see, e.g., Carnoy, Jacobsen, Mishel, and Rothstein 2005). Others have argued that while No Excuses programs may benefit relatively high-achieving and motivated students, those who need the most support - such as English language learners and special education students - are poorly served (see, for example, Rothstein, 2004; United Federation of Teachers, 2010). There are few well-controlled studies that might help sort out these competing claims, and none that focus on KIPP.[1]

This paper reports on a quasi-experimental evaluation of the effect of attending the sole KIPP school in New England, KIPP Academy Lynn in Lynn, Massachusetts. KIPP Lynn is unusual among charter schools in that it enrolls a high proportion of Hispanic, limited English proficient (LEP), and special education students, and so affords the opportunity to evaluate achievement gains for these important groups. Moreover, while the results reported here are from just one school, a signal feature of the KIPP model is a large measure of program standardization and, hence, replicability (Whitman, 2008). We might therefore expect similar gains and interactions to emerge from a larger sample of KIPP schools.

Our results show overall MCAS reading gains of about 0.12 standard deviations (hereafter, σ) for each year a student spends at KIPP, with significantly larger gains for special education and LEP students of about 0.3-0.4σ. Students attending KIPP gain an average of 0.35σ per year in math;

[1] See, for example, the studies linked at http://www.kipp.org/01/independentreports.cfm. The Hoxby and Murarka (2009) sample includes four KIPP schools in New York City, but results for these schools are not separately reported.

these effects are slightly larger for LEP and special education students. Results from a specification that interacts KIPP attendance with baseline scores suggest that KIPP raises scores more for those whose achievement lags their peers', while Hispanic and non-Hispanic students gain about equally from time in KIPP. Finally, an examination of Massachusetts Comprehensive Assessment System (MCAS) performance categories (similar to quartiles) shows that KIPP Lynn boosts achievement primarily by moving students up from the lowest group. Together, therefore, the findings reported here strongly suggest that KIPP Lynn benefits the weakest students most.

The next section provides some background on KIPP Lynn. Following that, Section III describes the data and our lottery-based estimation framework. Section IV presents the results, including estimates in subgroups and from models with baseline score interactions. The paper concludes in Section V.

II. Background

Students in Lynn Public Schools (LPS) score about a third of a standard deviation below the Massachusetts average on standardized tests. This is documented in Table 1, the first two columns of which show average characteristics (including 4th grade scores) of students in grade five, the entry grade for KIPP Lynn. KIPP Lynn applicants have somewhat lower test scores than the average Lynn student, with (pre-lottery) math and reading scores that are well below the state average (because scores are standardized, the averages shown in columns 1-2 measure the difference between LPS or KIPP students and the state mean). While the population of Lynn is more than two-thirds white, most of the 13,000 students in LPS are nonwhite and nearly 80 percent are eligible for a free or reduced-price lunch. About a fifth of both the LPS and KIPP Lynn populations are designated LEP, while a fifth are categorized as special education students.

KIPP Lynn, which opened in the Fall of 2004, serves about 300 students in grades five through eight. Each KIPP school sets its own curriculum, but KIPP Lynn shares many features with other KIPP schools across the nation. KIPP Lynn operates with a long school year, starting in August and including some Saturdays, and a long school day, running from 7:30 in the morning to 5:00 in the afternoon. The school emphasizes basic reading and math skills. Students are expected to adhere to a behavioral code, which includes speaking only when called on in class and orderly movement between classes. Students receive "paychecks," points awarded for good work that can be spent on field trips and other perks. Parents or guardians, students, and teachers are asked to sign a "Commitment to Excellence," a promise to come to school on time and work hard, among other things.

The KIPP Lynn and LPS student-teacher ratios are similar, at around 14. In most other ways,

however, the KIPP and LPS staffing models diverge. KIPP Lynn's teachers are not unionized, work an unusually long day, and are expected to respond to students phone calls in the evening. KIPP was founded by alumni of the national Teach For America (TFA) internship program, and many KIPP Lynn teachers are graduates of TFA. KIPP Lynn teachers are much younger than those in the rest of LPS: 88 percent are 40 or under, compared to 29 percent in LPS. Perhaps reflecting their age, KIPP teachers are far less likely to be licensed in their teaching assignment (26 percent, compared to 98 percent in LPS).[2]

Most KIPP Lynn students live in Lynn and would otherwise attend an LPS school. A handful of applicants come from Catholic schools or other charter schools. Like most other Massachusetts charter schools, KIPP Lynn is funded primarily through tuition paid by students' sending districts. Tuition is typically set to match sending districts' average per-pupil expenditure. This amount is offset by state subsidies to the sending district when a student first transfers out.

Statewide regulations require that Massachusetts charter schools use a lottery when over-subscribed. KIPP Lynn was under-subscribed when it opened in the Fall of 2004, and only marginally over-subscribed in 2005. More recently, however, more than 200 students have applied for about 90 seats. The 2005-8 admissions lotteries are used here to develop a quasi-experimental research design. These randomized lotteries allow us to estimate the causal effect of KIPP Lynn on achievement, solving the problem of selection bias that plagues most studies of school effectiveness.

III. Data and Empirical Framework

A. Data

We obtained lists of KIPP Lynn applicants for the Fall of 2005 through 2008, focusing on first-time applicants to fifth grade, KIPP's principal entry point. These lists were matched to the Massachusetts Student Information Management System (SIMS), a database with demographic and other information for all public school students in the state. As shown in Appendix Table A1 (and discussed at greater length in the data appendix), 91 percent of KIPP applicants were located in the SIMS database.

KIPP lottery winners were more likely to be matched to the SIMS than losers, a difference of about 11 percent. Among those whose application indicates that they currently attend an LPS school, however, the differential is only 0.029 (s.e.=0.027). This pattern suggests that the SIMS match differential is driven mainly by the tendency of private (mostly Catholic) school applicants to remain in private school if they lost the KIPP lottery, a problem we can avoid by looking at applicants from

[2]Statistics in the paragraph are calculated from data available at http://profiles.doe.mass.edu, accessed January 28, 2010.

LPS only. As we show below, limiting the analysis to LPS applicants yields effects very similar to those in the full set of applicants. This suggests that the difference in match rates does not bias our findings.

In 5th through 8th grades, students are tested in math and English language arts (ELA) as part of the MCAS. Our analysis uses MCAS scores from the Spring of 2006-9. We normalized these scores (to a statewide mean of zero and standard deviation of one) by subject, grade and year and matched them to KIPP applicants' SIMS records. The sample used for statistical analyses includes only the applicants who were subject to random assignment, omitting those with siblings already enrolled in KIPP (who are guaranteed a slot), late applicants (who miss the lotteries), older applicants (who enter late if at all), as well as few students with missing demographic data. There are 457 matched students with demographic data subject to random assignment. Dropping a further 38 applicants for whom we would not expect to have scores by the Spring of 2009 by virtue of their grade and date of application, leaves 419 who should have MCAS outcomes and 401 who do. The effect of these selection criteria on the size of the lottery sample is documented in Appendix Table A2.

Table 2 lists the lottery cohorts contributing to this study, the share of randomized applicants who won entry to KIPP, and the share that attended. Of the 457 matched students subject to random assignment, 69 percent were offered a spot at KIPP Lynn and 54 percent enrolled. As the table makes clear, the earliest cohorts to apply to KIPP Lynn contribute more data to our analysis than do more recent cohorts, since they've taken more tests. For example, from 2006 through 2009, the 2005 applicant cohort was tested in 5th through 8th grade, while the 2008 applicant cohort was tested in 5th grade only. Overall, lottery winners spent an average of about 1.85 years at KIPP Lynn in our sample period (as shown in last column of Table 2), but the 2005 cohort spent an average of 2.6 years in KIPP while the 2008 cohort spent only 0.7 years at KIPP. Since our test score data is weighted toward the earliest KIPP cohorts, the results reported here should be interpreted as the effect of a relatively new school on its first cohorts of students.

Table 1 reports descriptive information for 5th graders attending LPS and KIPP Lynn during our study period, as well as for the estimation sample of KIPP Lynn applicants. KIPP Lynn applicants look much like the students who ultimately enroll in KIPP. Importantly, lottery winners and losers appear to be similar, a fact documented in column (4) of Table 1, which reports differences in demographic characteristics and baseline scores between those who win and lose the lottery. By virtue of random assignment, we would expect these differences to be small. In practice, however, our reconstruction of the KIPP lotteries is based on spreadsheets that may be missing some information. In particular, for some applicants, lottery status was over-written with enrollment status. We attempted to fix this by reviewing the lottery records with school staff. It is therefore encouraging that most pre-

treatment characteristics come out balanced. Specifically, regression estimates with pre-treatment characteristics on the left-hand side show only one significant difference between winners and losers (proportion Asian), and the F-statistic from a joint test of balance on all observable characteristics gives little cause for concern. Differences in LEP rates, baseline scores, and the proportion of applicants in fourth grade shrink further when adjusted for the demographic variables in the upper half of Table 1, as can be seen in column (5).[3]

While Table 1 shows that lottery winners and losers are similar at the time of the lottery, subsequent attrition may generate important differences in the follow-up sample if the attrition process is non-random. Of particular concern is the possibility that lottery losers are more likely to be missing. The MCAS is a statewide test, but KIPP applicants who enroll in private school or leave Massachusetts altogether are lost to follow-up.

Table 3 probes for evidence of differential attrition between lottery winners and losers. Given the entry cohorts and tested grades of the lottery applicants, we expect to observe 971 test scores after the lottery (Appendix Table A3 lists the number of test scores expected and observed for each applicant cohort). Among those who lose the lottery, about 85% of expected scores were found. This rate is about five percentage points higher for those who win the lottery, a difference that shrinks and become insignificant with the inclusion of demographic controls.[4] The small follow-up differentials documented in Table 3 seem unlikely to impart substantial selection bias in our impact analysis.

B. 2SLS Strategy

We are interested in the causal effect of attending KIPP Lynn on test scores. This effect is modeled as a function of time spent attending KIPP Lynn in the equation

$$y_{igt} = \alpha_t + \beta_g + \sum_j \delta_j d_{ij} + \gamma' X_i + \rho s_{igt} + \epsilon_{igt}, \tag{1}$$

where y_{igt} denotes the scores of student i tested in year t in grade g. The variable s_{igt} records calendar years spent at KIPP Lynn as of the test date, counting any repeated grades. The (average) causal effect of interest is ρ. The terms α_t and β_g are year-of-test and grade-of-test effects, while X_i is a vector of demographic controls with coefficient γ, and ϵ_{igt} is an error term that captures random fluctuation in test scores. The dummies d_{ij} indicate three of the four KIPP Lynn application cohorts, indexed by j. Note that application cohort is an important control variable because the probability

[3]The estimates in column (4) control for year and grade of application (except for the row for application grade). The column (5) models add all demographic controls with the exception of LEP status to the regressions for LEP, baseline scores, and 4th grade application status.

[4]The attrition regressions include the same controls as the first stage equations discussed in the next section.

of winning a seat at KIPP varies from year to year.[5]

We use randomly assigned lottery offers as an instrument for s_{igt}. The first stage equation takes the form:

$$s_{igt} = \lambda_t + \kappa_g + \sum_j \mu_j d_{ij} + \Gamma' X_i + \pi Z_i + \eta_{igt}, \tag{2}$$

where λ_t and κ_g are year-of-test and grade effects. The excluded instrument is the lottery offer dummy Z_i, with first stage effect π. The reduced form generated by this system comes from substituting (2) for s_{igt} in (1). The reduced form effect is the coefficient on Z_i in a regression of y_{igt} on Z_i, with the same controls and data structure as for equations (1) and (2). Because the model is just-identified, 2SLS estimates of ρ are given by the ratio of reduced form to first stage coefficients.

IV. Results

The lottery first stage is a little over 1.2 years, as can be seen in the first column of Table 4. This estimate indicates that, at the time they were tested, lottery winners had spent an average of 1.2 years more at KIPP than lottery losers. The addition of demographic variables and baseline scores has almost no effect on the first stage estimates.[6] In a world with perfect lottery compliance, no late entry or grade repetition, and no loss to follow-up, the first stage in our sample would be 1.75, but this is reduced by the fact that some winners never enroll in KIPP or leave before finishing and some losers end up in KIPP later.[7] On the other hand, although KIPP schools are sometimes said to encourage weaker students to leave (see, e.g., the discussion in chapter 46 of Mathews, 2009), we found that lottery winners were about as likely as losers to change schools in grades 6-8, a result discussed further, below.

Lottery winners score about 0.4 standard deviations higher than losers in math. This reduced-form estimate is reported in column (2) in the top half of Table 4. This result is robust to the inclusion of demographic controls and baseline scores. The reduced-form estimates for ELA, reported in the bottom half of the table, are more variable across specifications, ranging from $0.14-0.22\sigma$ as the set of

[5]Siblings who apply together are more likely to get in, since a winning sibling improves the loser's position on the waiting list. All specifications therefore include a dummy indicating the presence of an applicant's sibling in the lottery, as well as the interaction of this dummy with year of application. Note that applicants with siblings *already* enrolled in KIPP are excluded from the analysis sample, since they are guaranteed admission.

[6]We report separate first stages for math and ELA because samples differ slightly by subject.

[7]The 2005 cohort contributes one score after one year (in 5$^{\text{th}}$grade), one after two years (in 6$^{\text{th}}$grade), one after three years (in 7$^{\text{th}}$grade), and one after four years (in 8$^{\text{th}}$grade) for an average of 2.5 years in KIPP across grades. A similar calculation for the other cohorts, who are seen in fewer grades, produces 2.0 potential years in KIPP for the 2006 cohort, 1.5 potential years in KIPP for the 2007 cohort, and one potential year in KIPP for the 2008 cohort. The average of these is 1.75.

controls changes. This variation probably reflects the modest imbalance between winners and losers in the proportion LEP documented in Table 1. The estimated effect on ELA is marginally significant in models with demographic and baseline score controls.

Because the first-stage coefficients are over one, the 2SLS estimates are smaller than the reduced-form estimates, though they also have a different interpretation. The 2SLS estimates imply that math scores increase by about 0.35σ for each year at KIPP Lynn. The more modest 2SLS estimates for ELA show per-year gains on the order of $0.1 - 0.15\sigma$. The most precise of these is 0.12σ, estimated in models with demographic and baseline score controls (s.e.=0.058). These effects are remarkably similar to the middle school results from a sample of No Excuses charter schools in Boston, as reported in Abdulkadiroğlu et al. (2009). Measured against Lynn's Hispanic-White score gaps of about 0.5σ in math and 0.6σ in ELA, both the math and ELA effects are substantial. Perhaps surprisingly, the OLS estimates of math effects reported in column (4) of Table 4 are close to the corresponding 2SLS estimates, though the OLS estimates of ELA effects are a little larger. The similarity of OLS and 2SLS estimates (and the fact that the OLS estimates are insensitive to controls) suggests that, in the sample of KIPP Lynn applicants, selection bias is minor.[8]

We noted above that our reconstruction of the KIPP Lynn lotteries may have been imperfect because some lottery offer data was replaced with enrollment data. This is probably more of a concern for older applicants, who are less likely than 4th grade applicants to have accepted a KIPP offer (since 5th grade and older applicants were required to repeat their current grade). Therefore, as a robustness check, Table 4 reports results for the sample of 4th grade applicants only. These results, shown in columns (5) and (6), are similar to the main findings. Likewise, because match rates from lottery data to SIMS data were higher for students coming from a Lynn public school, we report results from the sample of LPS applicants only in columns (7) and (8). These too are close to the findings reported for the full sample.

To get a sense of whether the KIPP Lynn treatment effect has been increasing over time, Figure 1 plots reduced-form estimates by cohort and grade, starting in fourth grade to document baseline differences.[9] Not surprisingly, treatment effects estimated at this level of disaggregation are fairly noisy and few are individually significant. On the other hand, the math results appear to have increased somewhat for more recent applicant cohorts, while the evolution through grades suggests

[8] We also experimented with an alternative IV model where the instrument is the grade- and cohort-specific potential time in KIPP for winners. This is the first-stage specification used by Hoxby and Murarka (2009). The first stage in this case indicates that each potential year in KIPP causes about 0.7 actual years in KIPP, as shown in column (1) of Appendix Table A4. The corresponding 2SLS results, reported in column (6) of Table A4, are slightly more precise but otherwise similar to the 2SLS estimates reported in Table 4.

[9] The sample used to construct Figure 1 includes 4th grade applicants only. The reduced-form estimates plotted in the figure come from models that include demographic controls.

a cumulative effect. Consistent with the smaller pooled estimates for ELA, the ELA estimates in the plot are mostly smaller than the math estimates and take longer to emerge. The math and ELA results both show an (insignificant) negative effect in 8th grade but this result comes from a single cohort - KIPP Lynn's second, admitted in 2005 - for which the first stage is also relatively small.

A. Subgroups and Interactions

KIPP Lynn serves more Hispanic, LEP, and special education students than the typical charter school in the Northeast. Table 5 looks at effects in these subgroups. The first two columns of the table show math impacts that are markedly larger for LEP students, while ELA score gains come almost entirely from the LEP group. Results broken down by special education status look much like the analysis by LEP. On the other hand, the estimates are reasonably similar for Hispanic and non-Hispanic students, as can be seen in columns (5) and (6).

Charter skeptics have sometimes argued that while the most motivated and able students may benefit from charter school attendance, weaker students lose out. For instance, Rothstein (2004, p. 82) writes about KIPP: "They select from the top of the ability distribution those lower-class children with innate intelligence, well-motivated parents, or their own personal drives, and give these children educations they can use to succeed in life." Note that this is a concern about treatment effect heterogeneity rather than selection bias.

We explored this type of treatment effect heterogeneity by estimating a model that adds an interaction between applicants' baseline (4th grade) scores and years at KIPP Lynn, normalized so that the main effect of years at KIPP Lynn is evaluated at the mean of the baseline score distribution. Table 6 shows that KIPP Lynn raises achievement *more* for weaker students. Children with baseline scores half a standard deviation below the applicant mean appear to get about an additional achievement boost of about $0.05\sigma - 0.08\sigma$ from each year at KIPP, relative to a student with baseline scores at the mean. This finding echoes a similar negative interaction with baseline scores reported in our Boston study (Abdulkadiroğlu et al., 2009).

As part of the No Child Left Behind (NCLB) accountability process, the Massachusetts Department of Elementary and Secondary Education reports the distribution of MCAS scores across four mutually exclusive categories: advanced, proficient, needs improvement, and warning. Under current NCLB provisions, a school meets the required Adequate Yearly Progress (AYP) standard if the overall school average and various subgroup averages are proficient or better. Table 7 reports the effect of KIPP Lynn on the likelihood of falling into each of the MCAS score groups. A year at KIPP Lynn reduces the probability that students perform at the warning level by 10 percentage points for math, with an equal increase in the likelihood of reaching an advanced level. For ELA, the table shows a 5 percentage

point drop in the warning group, and with an equal increase in the probability of attaining the needs improvement category. While the gains are more impressive for math than for ELA, it is noteworthy that achievement gains in both subjects come from a shift out of the lowest group.

B. School Switching

Finally, we look briefly at whether the positive effects reported here might be explained by high rates of exit from KIPP. This inquiry is motivated by evidence that KIPP schools in the San Francisco Bay area experienced high rates of exit, though it is not clear whether these rates are out of line with those in the host public school districts (Woodworth, et al., 2008). Our school switching analysis uses the same empirical framework as that used to investigate attrition in Table 3, though the dependent variable in this case indicates whether a KIPP applicant changes schools between grades five and eight. These results, reported in the first row of Table 8, show that KIPP Lynn lottery winners were much *less likely* to change schools than those who lost the lottery. This difference is attributable to the fact that KIPP Lynn students stay at KIPP in the transition from 5th to 6th grade, when LPS students move from elementary to middle school. Excluding the transition from 5th to 6th grade, the results show no difference in switching between winners and losers, as can be seen in the last row of Table 8. This weighs against the view that exit from KIPP matters for the achievement gains reported here.

V. Concluding Comments

Our estimates suggest that KIPP Lynn generates substantial score gains for lottery winners, with effects on the order of 0.35σ for math and 0.12σ for ELA. Score gains are largest for special education students and students with limited English proficiency, while Hispanic and non-Hispanic students appear to benefit about equally from time in KIPP. A specification that interacts KIPP attendance with baseline scores indicates that effects are also larger for those who start out lagging their peers than for more advanced students. An analysis of effects on MCAS performance categories shows that KIPP lifts students out of the lowest performance category in both math and ELA.

A recent charter study concludes that newly opened charter schools do worse than traditional public schools (Zimmer, Gill, Booker, Lavertu, Sass and Witte 2009). It's therefore worth emphasizing that the results reported here are from the first few cohorts to attend KIPP Lynn. Finally, we note that while our results are for a single school, the KIPP organization runs similar schools across the country. Key elements of the KIPP program also feature in other No Excuses charter schools, such as those in our Boston sample. Our findings suggest the major elements of this replicable model combine to increase achievement overall, with the largest gains coming from relatively weak students.

Table 1: Descriptive Statistics and Covariate Balance

	Means			Balance regressions	
	Lynn Public 5th graders	KIPP Lynn 5th graders	KIPP Lynn lottery applicants	No controls	Demographic controls
	(1)	(2)	(3)	(4)	(5)
Hispanic	0.418	0.565	0.538	-0.052	-
				(0.053)	
Black	0.173	0.235	0.254	0.027	-
				(0.044)	
White	0.296	0.168	0.182	-0.010	-
				(0.040)	
Asian	0.108	0.021	0.022	0.026*	-
				(0.015)	
Female	0.480	0.474	0.484	-0.010	-
				(0.054)	
Free/reduced price lunch	0.770	0.842	0.825	-0.030	-
				(0.041)	
Special Education	0.185	0.189	0.197	-0.013	-
				(0.042)	
Limited English Proficiency	0.221	0.172	0.206	-0.075	-0.060
				(0.047)	(0.044)
Baseline Math Score	-0.307	-0.336	-0.390	0.097	0.066
				(0.114)	(0.109)
Baseline Verbal Score	-0.356	-0.399	-0.438	0.054	0.028
				(0.118)	(0.109)
Fourth Grade Applicant			0.768	0.056	0.068
				(0.046)	(0.047)
F-value from joint test				0.820	0.998
p-value from F-test				0.621	0.409
N for demographics	3964	285	457	457	457
N for baseline Math	3808	284	446	446	446
N for baseline ELA	3805	284	447	447	447

Notes: Columns (1), (2), and (3) report means of the variable indicated in each row. Column (1) reports 4th grade means for students that attended 5th grade in Lynn public schools in Fall 2005-2008. Column (2) reports 4th grade means for all students who attended KIPP Academy Lynn in these years, and column (3) reports 4th grade means for lottery applicants to KIPP Academy Lynn over the same period. The sample for columns (3)-(6) is restricted to randomized applicants with baseline demographics and excludes students who had completed 6th or 7th grade prior to applying. Column (4) reports coefficients from regressions of the variable indicated in each row on an indicator variable equal to one if the student won the lottery. These regressions include dummies for year of application and exclude students with sibling priority and those without baseline demographics. With the exception of the "4th grade applicant" row, regressions also include application grade dummies. Column (5) adds all of the demographic controls with the exception of LEP to the regressions for LEP, baseline scores, and 4th grade application. F-tests are for the null hypothesis that the coefficients on winning the lottery in all regressions are equal to zero. These tests statistics are calculated for the subsample that has non-missing values for all variables tested.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 2: KIPP Academy Lynn Lotteries

Lottery Cohort	Calendar years observed	Grades observed	Number of applicants	Number of applicants in lottery sample	Percent offered	Percent attended	Average years at KAL (winners)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2005-2006	2006-2009	5-8	138	107	0.925	0.673	2.556
2006-2007	2007-2009	5-7	117	86	0.674	0.535	2.293
2007-2008	2008-2009	5-6	167	127	0.654	0.567	1.711
2008-2009	2009	5	207	137	0.540	0.401	0.703
All cohorts	2006-2009	5-8	629	457	0.687	0.536	1.847

Notes: This table reports characteristics of the four lotteries conducted at KIPP Academy Lynn from 2005 to 2008. Column (2) reports the calendar years (Spring) in which test scores are observed for applicants in each lottery cohort, and column (3) reports the corresponding outcome grades. Column (4) gives the total number of applicants in each year, and column (5) gives the number of applicants in the lottery sample, which excludes sibling applicants, late applicants, repeat applicants, applicants without baseline demographics, applicants who could not be matched to the MCAS data, and applicants who had completed 6th or 7th grade prior to the lottery. Columns (6)-(8) give summary statistics for the lottery sample.

Table 3: Attrition

		Differential Follow-up (winner - loser)		
	Proportion of non-offered with MCAS scores	Basic controls	Demographics	Demographics and baseline scores
Subject	(1)	(2)	(3)	(4)
Math	0.851	0.052*	0.041	0.044
		(0.032)	(0.031)	(0.030)
		971	971	957
ELA	0.855	0.048	0.031	0.041
		(0.031)	(0.032)	(0.031)
		971	971	958

Notes: This table reports coefficients from regressions of an indicator variable equal to one if the outcome test score is non-missing on an indicator variable equal to one if the student won the lottery. Grades are pooled, and all regressions include grade dummies. The regression in column (2) includes dummies for outcome grade, year of baseline, application grade, and year of application interacted with a contemoraneous sibling applicant dummy. Column (3) adds demographic variables, and column (4) adds baseline test scores. The sample is restricted to cohorts for which we should observe follow-up scores and excludes applicants with sibling priority. Robust standard errors (clustered at the student level) are reported in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 4: Lottery Results

		all applicants				4th grade applicants		Lynn public schools at baseline	
		First Stage	Reduced Form	2SLS	OLS	2SLS	OLS	2SLS	OLS
Subject	Controls	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Math	Basic	1.222***	0.431***	0.353***	0.304***	0.368***	0.272***	0.342***	0.308***
		(0.063)	(0.116)	(0.095)	(0.048)	(0.100)	(0.052)	(0.109)	(0.054)
		865	865	865	865	752	752	704	704
	Demographics	1.232***	0.392***	0.318***	0.316***	0.356***	0.302***	0.309***	0.336***
		(0.065)	(0.105)	(0.084)	(0.041)	(0.087)	(0.045)	(0.098)	(0.046)
		865	865	865	865	752	865	704	704
	Demographics &	1.228***	0.425***	0.346***	0.317***	0.336***	0.319***	0.341***	0.346***
	Baseline Scores	(0.066)	(0.066)	(0.052)	(0.032)	(0.055)	(0.036)	(0.064)	(0.038)
		856	856	856	856	746	746	696	696
ELA	Basic	1.223***	0.183	0.150	0.170***	0.188*	0.138***	0.217*	0.168***
		(0.063)	(0.117)	(0.094)	(0.049)	(0.099)	(0.052)	(0.115)	(0.057)
		866	866	866	866	751	751	705	705
	Demographics	1.235***	0.118	0.095	0.172***	0.152*	0.164***	0.150	0.180***
		(0.066)	(0.097)	(0.077)	(0.041)	(0.080)	(0.043)	(0.092)	(0.047)
		866	866	866	866	751	866	705	705
	Demographics &	1.234***	0.149**	0.120**	0.172***	0.111*	0.168***	0.132*	0.182***
	Baseline Scores	(0.066)	(0.073)	(0.058)	(0.031)	(0.059)	(0.033)	(0.068)	(0.036)
		856	856	856	856	744	744	698	698

Notes: This table reports the coefficients from regressions of test scores on years spent at KIPP Academy Lynn. The sample uses students who applied to KIPP Lynn between 2005 and 2008. It is restricted to students with baseline demographic characteristics and excludes applicants with sibling priority. Grades are pooled, and all regressions include grade dummies. All regressions also include year of test dummies, year of application dummies interacted with a contemporaneous sibling applicant dummy, and grade of application dummies. Some regressions add demographic controls, which include dummies for female, black, hispanic, asian, other race, special education, limited english proficiency, free/reduced price lunch, and a female*minority interaction. Columns (1)-(3) report the first stage, reduced from, and 2SLS coefficients from instrumenting years in KIPP Lynn using the lottery win/loss dummy. Column (4) reports the coefficients from OLS regressions of test scores on years in KIPP Lynn and controls. Columns (5) and (6) report 2SLS and OLS results using only students that applied to KIPP Lynn in the year after finishing 4th grade. Columns (7) and (8) report 2SLS and OLS results using only students that indicated Lynn Public School attendance prior to the lottery on their KIPP Lynn applications. Robust standard errors (clustered at the student level) are reported in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5: Lottery Results in Subsamples

Subject	Controls	LEP (1)	Non-LEP (2)	SPED (3)	Non-SPED (4)	Hispanic (5)	Non-hispanic (6)
Math	Basic	0.700***	0.208**	0.484**	0.298***	0.413***	0.247
		(0.182)	(0.101)	(0.207)	(0.092)	(0.118)	(0.150)
		132	733	175	690	462	403
	Demographics	0.628***	0.254***	0.527**	0.271***	0.302***	0.358**
		(0.197)	(0.093)	(0.215)	(0.087)	(0.106)	(0.152)
		132	733	175	690	462	403
	Demographics and Baseline Scores	0.451***	0.312***	0.441***	0.325***	0.346***	0.331***
		(0.155)	(0.056)	(0.146)	(0.053)	(0.074)	(0.076)
		131	725	174	682	457	399
ELA	Basic	0.457**	-0.016	0.346	0.077	0.217*	0.004
		(0.203)	(0.095)	(0.216)	(0.087)	(0.117)	(0.157)
		131	735	176	690	463	403
	Demographics	0.416**	0.019	0.220	0.038	0.068	0.119
		(0.183)	(0.084)	(0.216)	(0.079)	(0.093)	(0.150)
		131	735	176	690	463	403
	Demographics and Baseline Scores	0.384***	0.051	0.298*	0.049	0.121	0.086
		(0.140)	(0.062)	(0.162)	(0.058)	(0.075)	(0.099)
		130	726	174	682	457	399

Notes: This table reports results analogous to the 2SLS estimates in Table 4. The reported coefficients are 2SLS estimates in subsets of the lottery sample. The sample for each regression is restricted to individuals who were classified as limited english proficient (LEP), special education (SPED), or Hispanic at baseline in columns (1) , (3) and (5), compared to those who were not in columns (2) , (4) and (6), respectively. The LEP estimation sample includes 79 students, while the non-LEP sample includes 319. The SPED estimation sample includes 78 students, while the non-SPED sample includes 320. The Hispanic estimation sample includes 220 students, while the non-Hispanic sample includes 178. Robust standard errors (clustered at the student level) are reported in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: Baseline Test Score Interactions

	Baseline Scores		Demographics + Scores	
	Main effect	Interaction	Main effect	Interaction
Subject	(1)	(2)	(3)	(4)
Math	0.362***	-0.087**	0.367***	-0.106***
	(0.057)	(0.043)	(0.054)	(0.041)
	856		856	
ELA	0.128**	-0.147***	0.139**	-0.157***
	(0.064)	(0.051)	(0.057)	(0.045)
	856		856	

Notes: This table reports results analogous to the 2SLS estimates in Table 4, but specifications now include an interaction of baseline test score with years at KIPP Academy Lynn. These regressions use the KIPP Lynn offer dummy and offer*baseline score as instruments for years in KIPP Lynn and the interaction term. A main effect of baseline test score is also included in all regressions. Baseline scores are mean-zero in the estimation sample so that the main effects of years in KIPP Lynn are at the mean. Robust standard errors (clustered at the student level) are reported in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Effects on MCAS Performance Levels

Subject	Warning (1)	Needs Improvement (2)	Proficient (3)	Advanced (4)
Math	-0.100***	-0.019	0.016	0.103***
	(0.028)	(0.038)	(0.039)	(0.026)
	856	856	856	856
ELA	-0.055***	0.068*	-0.005	-0.003
	(0.020)	(0.037)	(0.037)	(0.017)
	856	856	856	856

Notes: This table reports the coefficients from 2SLS regressions of indicator variables for each of the 4 MCAS performance levels on years in KIPP Lynn instrumented by the lottery offer dummy. Grades are stacked. Controls include demographics and baseline scores. Robust standard errors (clustered at the student level) are reported in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

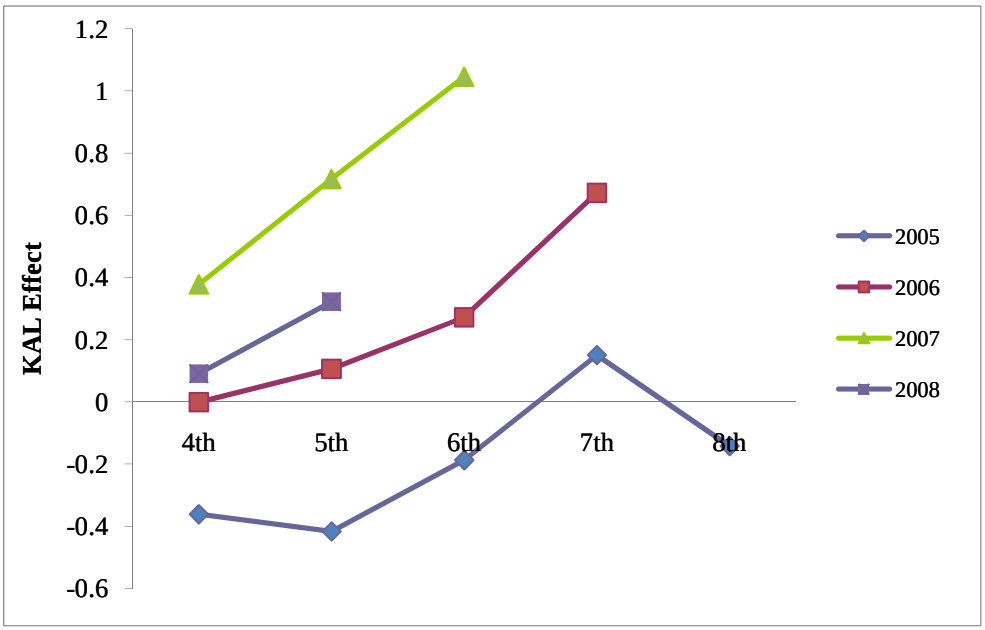
Table 8: School Switching Regressions

	Mean for non-offered students	Differential Follow-up (winner - loser)		
		Basic controls	Demographics	Demographics and baseline scores
	(1)	(2)	(3)	(4)
Any switch	0.504	-0.278***	-0.291***	-0.294***
		(0.044)	(0.044)	(0.045)
		419	419	412
6th grade school is different from 5th	0.855	-0.495***	-0.503***	-0.509***
		(0.061)	(0.060)	(0.059)
		294	294	291
Any switch excluding 5th to 6th transition	0.081	-0.004	-0.006	-0.004
		(0.033)	(0.033)	(0.034)
		419	419	412

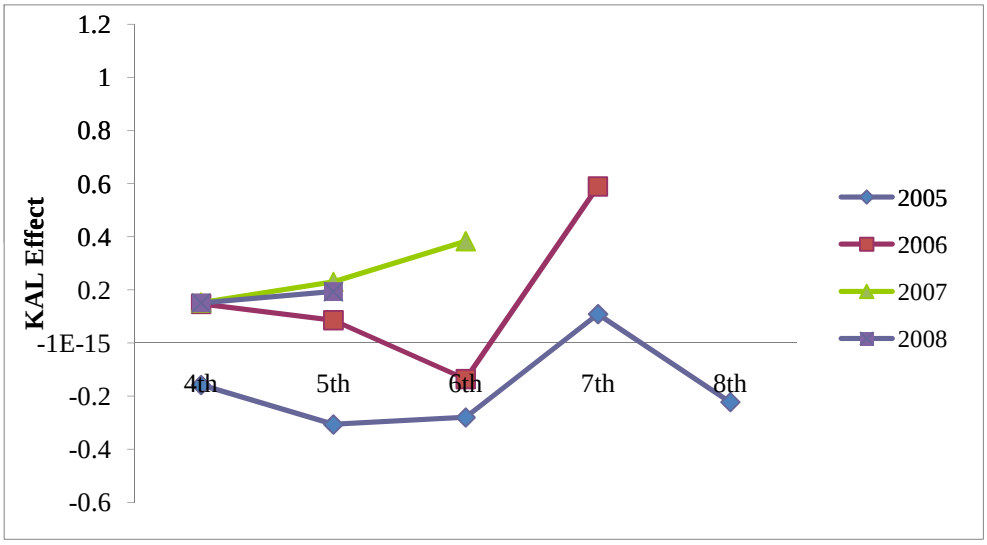
Notes: This table reports coefficients from regressions of an indicator variable equal to one if a student switched schools on an indicator variable equal to one if the student won the KIPP Academy Lynn lottery. The dependent variable in the first row is one if a student ever moves from one observed school to another from 4th to 8th grade, either within a school year or between school years. The dependent variable in the second row is one if a student switches schools between 5th and 6th grade; only observations where both schools are observed are used. The dependent variables in the the third row is 1 if a student switches schools at any time besides the transition from 5th to 6th grade. The regressions in column (2) include dummies for outcome grade, year of baseline, application grade, and application year interacted with a contemporaneous sibling applicant dummy. Column (3) adds demographic variables, and column (4) adds baseline Math and ELA scores. The sample is restricted to cohorts for which we should observe follow-up test scores and excludes applicants with sibling priority. Robust standard errors are reported in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

Figure 1



A. Math Reduced Form



B. ELA Reduced Form

Notes: This figure plots the coefficients from a regression of test scores on the lottery offer dummy interacted with dummies for grade of test*application year. Basic and demographic controls are included.

Data Appendix

Data for this project come from lottery records from KIPP Academy Lynn, student demographic and school attendance information in the Massachusetts Student Information Management System (SIMS), and test scores from the Massachusetts Comprehensive Assessment System (MCAS) state database. This appendix describes these data sets and details the procedures used to clean and match them.

A. Data Sets

KIPP Academy Lynn Lottery Data

Data description and sample restrictions

Our sample of applicants is drawn from records of the four lotteries that took place at KIPP Academy Lynn from 2005 through 2008. These records include applicants' names, date of birth, previous school and grade, and contact information for a parent, guardian, or the name of a sponsoring organization such as the Lynn Boys Club. The first five rows of Table A2 summarize the raw lottery data and sample restrictions used here. A few students who repeated grades were listed in the lottery data to remind school staff to reserve an appropriate number of slots. These records are not included in the analysis sample. We also excluded duplicate records. If a student applied to KIPP Academy Lynn more than once, only the first application is included. Late applicants (after lotteries) were excluded as were siblings and students who went directly onto the waiting list (these are mostly 6th grade applicants in early cohorts). Imposing these restrictions reduces the number of lottery records from 629 to 542.

Coding the offer variable

Lottery records were used to reconstruct an indicator for whether applicants won the chance to attend KIPP Lynn through the lottery process. We coded this from information on whether each student attended KIPP Lynn in the year after the lottery, attempts to contact lottery winners, and offers that were declined. Attempts to contact winners and declined offers were not always recorded; we filled this in by reviewing each applicant record with school staff. Of the 542 randomized applicants in our lottery sample, 350 were coded as receiving offers.

Student Information Management System Data

Data description

This project uses SIMS data from the 2001-2002 school year through the 2008-2009 school year. Each year of data includes an October file and an end-of-year file. The SIMS records demographic and

attendance information for all Massachusetts public school students. SIMS records refer to a student in a school in a year, though there are some student-school-year duplicates for students that switch grades or programs within a school and year.

Coding of demographics and attendance

The SIMS variables of interest include grade, year, name, town of residence, date of birth, sex, race, special education (SPED) and limited English proficiency (LEP) status, free/reduced price lunch, and school attended. We constructed a wide-format data set that captures each student's demographic information for each grade in which he or she is present in the SIMS data. This file uses the demographic information from the longest-attended school in the first calendar year encountered for each grade. Attendance ties were broken at random (this affects only 0.014 percent of records). If a student is classified as SPED, LEP, or qualified for free/reduced price lunch in any record within a school-year-grade, then he or she is coded that way for the entire school-year-grade record.

KIPP Lynn attendance is measured in calendar years. A student was coded as attending KIPP Lynn when there is any SIMS record for KIPP attendance in that year. Our analysis uses grade of application as determined by the SIMS (as some parents record this incorrectly on lottery applications).

Massachusetts Comprehensive Assessment System Data

Data description and sample restrictions

This project uses MCAS data from the 2001-2002 school year through the 2008-2009 school year. Each record in the MCAS data corresponds to a student's test results for a given grade and year. We use Math and English Language Arts (ELA) tests from grades 4-8. Our outcome grades are 5-8, so only tests taken in 2006-2007 or later are used for these grades; prior years give baseline (4th grade) scores. We standardized scores to have mean zero and standard deviation one within a subject-grade-year in Massachusetts. Repetitions of the same test subject and grade were dropped. In one case with multiple records within a year and grade, scores were chosen at random.

B. Matching Data Sets

Match from the MCAS to the SIMS

The cleaned MCAS and SIMS files were merged by grade, year and a state student identifier known as the SASID. In grades 4-8, 99.3 percent of MCAS scores were matched to a student in the SIMS. Scores that could not be matched to the SIMS were dropped.

Match from the KIPP Academy Lynn lotteries to the SIMS/MCAS

Match procedure

Students in the lottery sample were matched to the SIMS data by name, pre-lottery grade, and year. In some cases, this did not produce a unique match, most often in cases where the lottery data were incomplete. We accepted some matches based on fewer criteria where the information on grade, year, and town of residence seemed to make sense.

Match success rates

Table A1 reports match rates from lottery records to the SIMS/MCAS file. The overall match rate is 91.3 percent (495 students out of 542). The match rate for offered students is 95.4 percent, while it is 83.9 percent for students who did not receive an offer. The differential is much lower for lottery applicants coming from an LPS school; the match rates for the offered and non-offered students in this subgroup are 96.4 percent and 93.4 percent, respectively. The differentials quoted in the text come from regressions of a match dummy on application year and LPS status (or just application year in the sample coming from LPS).

Construction of the Outcome Data Set

The lottery/SIMS/MCAS matched sample includes 495 lottery applicants with demographic and test score information. Of these, we use only students with baseline (4th grade) demographics in the SIMS. We also exclude 10 applicants who had completed 6th or 7th grade prior to the lottery, leaving a sample of 457 students. This is the sample of students used for the calculations reported in Table 2. Rows 6-8 of Table A2 summarize the impact of these restrictions on sample size.

Stacking grades

Outcome regressions stack grades and include multiple test scores for individual students. The follow-up window closes in Spring 2009, generating differences in the number of outcomes observed across lottery cohorts. For example, a 4th grade applicant for the 2005-2006 school year contributes 5th grade through 8th grade scores, whereas we see 5th grade only for 2008 applicants. Years in KIPP Lynn is defined as the number of school years spent at KIPP up to and including the outcome year.

Outcomes excluded from the sample

KIPP Lynn typically asked 5th grade applicants to repeat. These applicants might be expected to do better on 5th grade MCAS tests just by virtue of repeating. We therefore assume that all 5th grade applicants repeat and look only at their 6th grade and higher scores. We also drop a few 3rd grade applicants. These restrictions reduce the sample to 419, eliminating 38 2008-9 applicants from 5th grade (and a handful from 3rd).

Final set of outcomes and students

Table A3 summarizes the stacked analysis file. Of the 971 post-lottery outcomes we could hope to observe for each subject, we found 865 for Math and 866 for ELA; 401 of our 419 remaining students have at least one test score. These outcomes and students were used to produce the estimates in Table 4. For specifications that control for baseline test scores, the sample sizes are further reduced to 856 outcomes for both Math and ELA; 4 students out of 401 lack baseline Math and ELA scores.

Table A.1: Match from KIPP Academy Lynn lottery data to SIMS

	All applicants				Applicants from Lynn Public Schools			
		Fraction with SIMS match				Fraction with SIMS match		
Lottery cohort	Number of students (1)	Total (2)	Offered (3)	Not offered (4)	Number of students (5)	Total (6)	Offered (7)	Not offered (8)
2005-2006	122	0.943	0.955	0.833	103	0.971	0.968	1.000
2006-2007	102	0.931	0.971	0.848	76	0.934	0.963	0.864
2007-2008	143	0.916	0.955	0.852	100	0.960	0.971	0.935
2008-2009	175	0.880	0.939	0.828	117	0.949	0.947	0.950
All cohorts	542	0.913	0.954	0.839	396	0.955	0.964	0.934

Notes: This table summarizes the match from the KIPP Academy Lynn lottery data to the SIMS. The sample is restricted to students that meet all criteria from Table A.1. Columns (1)-(4) report statistics for all applicants, and columns (5)-(8) report statistics for students whose previous schools in the KAL lottery data are part of the Lynn Public School system.

Table A.2: KIPP Academy Lynn Lottery Records

	Lottery cohort				
	2005-2006	2006-2007	2007-2008	2008-2009	All lotteries
	(1)	(2)	(3)	(4)	(5)
Total number of records	138	117	167	207	629
Excluding KIPP students and duplicates within year	138	117	162	205	622
Excluding repeat applicants	138	115	158	196	607
Excluding late/non-randomized applicants	127	110	155	194	586
Excluding siblings	122	102	143	175	542
Excluding students not matched to the SIMS	115	95	131	154	495
Excluding students without baseline demographics	110	86	127	144	467
Excluding 6th and 7th grade applicants	107	86	127	137	457
Excluding applicants who should not have a test score	107	86	127	99	419

Notes: This table summarizes the raw KIPP Academy Lynn lottery data. The top row gives the total number of records, and each successive row adds sample restrictions. The second row eliminates KIPP Lynn students who repeat grades and are listed in the lottery data as placeholders, as well as duplicate student records within a lottery year. The third row keeps only the first lottery year in which a given student applies, and the fourth row excludes late (post-lottery) applicants as well as other non-randomized applicants. The fifth row eliminates students with sibling priority. The sixth row eliminates students who cannot be matched to the SIMS database. The seventh row excludes students without baseline (4th grade) demographics. The seventh row excludes students who had completed 6th or 7th grade prior to the lottery. The eighth row excludes students who should not have a non-repeat test score based on application grade and cohort (which eliminates 3rd and 5th grade applicants in 2008).

Table A.3: Outcome data for KIPP Academy Lynn Applicants

Lottery cohort	Number of students (1)	Number with an observed test score (2)	Number of test scores expected (3)	Math test scores observed (4)	ELA test scores observed (5)
2005-2006	107	105	405	357	361
2006-2007	86	84	238	212	211
2007-2008	127	122	229	206	204
2008-2009	99	90	99	90	90
All cohorts	419	401	971	865	866

Notes: This table summarizes observed test score outcomes for KIPP Academy Lynn applicants. The sample is restricted to randomized applicants who are matched to baseline (4th grade) SIMS demographics and who should have at least one test score. 6th and 7th grade applicants are excluded. Column (2) reports the number of students for whom at least one outcome is observed. Column (3) gives the number of test scores that should be observed (for both Math and ELA) given each applicant's lottery cohort and application grade. Columns (4) and (5) report the numbers of Math and ELA outcomes that are observed in the data.

Table A.4: Alternative Instruments

		Offer instrument			Alternative instrument		
		First Stage	Reduced Form	2SLS	First Stage	Reduced Form	2SLS
Subject	Controls	(1)	(2)	(3)	(1)	(2)	(3)
Math	Basic	1.222***	0.431***	0.353***	0.684***	0.206***	0.301***
		(0.063)	(0.116)	(0.095)	(0.039)	(0.063)	(0.089)
		865	865	865	865	865	865
	Demographics	1.232***	0.392***	0.318***	0.687***	0.185***	0.269***
		(0.065)	(0.105)	(0.084)	(0.040)	(0.057)	(0.077)
		865	865	865	865	865	865
	Demographics & Baseline	1.228***	0.425***	0.346***	0.688***	0.232***	0.337***
	Scores	(0.066)	(0.066)	(0.052)	(0.040)	(0.038)	(0.051)
		856	856	856	856	856	856
ELA	Basic	1.223***	0.183	0.150	0.685***	0.081	0.118
		(0.063)	(0.117)	(0.094)	(0.039)	(0.060)	(0.086)
		866	866	866	866	866	866
	Demographics	1.235***	0.118	0.095	0.689***	0.050	0.072
		(0.066)	(0.097)	(0.077)	(0.039)	(0.048)	(0.067)
		866	866	866	866	866	866
	Demographics & Baseline	1.234***	0.149**	0.120**	0.690***	0.091**	0.131**
	Scores	(0.066)	(0.073)	(0.058)	(0.039)	(0.038)	(0.054)
		856	856	856	856	856	856

Notes: This table reports instrumental variables results similar to those in Table 4. It is restricted to students with baseline demographic characteristics and excludes applicants with sibling priority. Grades are pooled, and all regressions include grade dummies. Columns (1)-(3) report the first stage, reduced form, and 2SLS coefficients from instrumenting years in KIPP Lynn with the lottery offer dummy as in Table 4. Columns (4)-(6) report results using potential years in KIPP Lynn interacted with the offer dummy as the instrument. Potential years in KIPP Lynn is calculated as the number of years a student would accumulate by attending KIPP Lynn in each post-lottery year until the outcome grade without repeating (except for 5th grade applicants, who are assumed to repeat one grade). Robust standard errors (clustered at the student level) are reported in parentheses.

* significant at 10%; ** significant at 5%; *** significant at 1%

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