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ABSTRACT

Who Benefits from KIPP?*

The nation's largest charter management organization is the Knowledge is Power Program (KIPP). KIPP schools are emblematic of the No Excuses approach to public education, a highly standardized and widely replicated charter model that features a long school day, an extended school year, selective teacher hiring, strict behavior norms, and a focus on traditional reading and math skills. No Excuses charter schools are sometimes said to focus on relatively motivated high achievers at the expense of students who are most diffiult to teach, including limited English proficiency (LEP) and special education (SPED) students, as well as students with low baseline achievement levels. We use applicant lotteries to evaluate the impact of KIPP Academy Lynn, a KIPP school in Lynn, Massachusetts that typifies the KIPP approach. Our analysis focuses on special needs students that may be underserved. The results show average achievement gains of 0.36 standard deviations in math and 0.12 standard deviations in reading for each year spent at KIPP Lynn, with the largest gains coming from the LEP, SPED, and low-achievement groups. The average reading gains are driven almost completely by SPED and LEP students, whose reading scores rise by roughly 0.35 standard deviations for each year spent at KIPP Lynn.

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I. Introduction

The question of whether charter schools boost academic achievement, and what types of students benefit most from charter attendance, remains controversial. This paper reports on an evaluation of one of the most widely-replicated charter models, a school in the Knowledge is Power Program (KIPP). KIPP is the nation's largest charter management organization (CMO), a network of schools that develops curricular materials, trains teachers and principals, and centralizes some administrative functions. KIPP schools exhibit a large measure of program standardization maintained through central and regional offices (Whitman, 2008). KIPP schools emphasize traditional math and reading skills, the development of a strong student work ethic, strict behavior norms, long school days and an extended school year. Ninety-nine KIPP schools serve 27,000 primarily low-income and minority students in 20 states and the District of Columbia.

The question of KIPP's effectiveness often arises in the debate over whether schools alone can close achievement gaps between racial and income groups. In a study of the racial achievement gap titled *No Excuses*, Thernstrom and Thernstrom (2003, p. 43) credit KIPP with impressive gains among low-income students, and conclude that "truly radical education innovation can change the lives of inner-city students, whatever their race or ethnicity." Detractors argue that KIPP's rigorous requirements attract families whose children would succeed anyway: "KIPP students . . . enter with substantially higher achievement than the typical achievement of schools from which they came. ...[T]eachers told us either that they referred students who were more able than their peers, or that the most motivated and educationally sophisticated parents were those likely to take the initiative to . . .enroll in KIPP (Carnoy, *et al.*, 2005)." In this view, the positive results seen at KIPP schools reflect selection bias.

Others have argued that while KIPP may be producing some gains, KIPP neglects students who are most in need. Charter critics have voiced concern that charter schools do not serve these populations and primarily benefit the most high-achieving and motivated students. For example, 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." In this view, KIPP is beneficial for students with significant academic potential, but is less effective for lower-achieving groups. See also the discussion in United Federation of Teachers (2010).

The causal effects reported here inform this debate. The setting for our study is KIPP Academy Lynn, a middle school founded in 2004 in Lynn, Massachusetts. Our analysis focuses on the effect of KIPP Lynn on students who are considered difficult to teach: those with low baseline test scores, who have limited English proficiency, or are classified as special needs. KIPP Lynn is unusual among

charter schools in the it enrolls a high proportion of Hispanic, limited English proficient (LEP) and special education (SPED) students, and so affords the opportunity to evaluate achievement gains for these important subgroups.

KIPP Lynn has been substantially over-subscribed since 2005. As required of all over-subscribed Massachusetts charter schools, KIPP Lynn uses a lottery to select incoming students. The KIPP admissions lottery generates instrumental variables that we use to eliminate selection bias in estimates of the causal effects of KIPP attendance. Although a burgeoning literature has used lotteries to evaluate charter schools, as far as we know, ours is the first study to use lotteries to evaluate a KIPP school.[1] We therefore provide unusually strong evidence on the causal effect of attending KIPP.

Our results show average reading score 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; these effects are slightly larger for LEP and special education students. We also produce separate estimates for students with different levels of baseline (4th grade) scores. The result suggests that effects are largest for those who start out behind their peers. Male and female students gain about equally in math, while boys benefit more than girls in reading. 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 suggest that KIPP Lynn benefits weak students the most.

We see the results for KIPP Lynn as revealing important possibilities. Although the conclusions that can be drawn from an analysis of a single school are naturally limited, KIPP's high degree of standardization suggests that results for KIPP Lynn may be relevant for the broader population of KIPP schools and students. As we describe further below, KIPP Lynn implements the key policies that characterize the general KIPP model. KIPP started in Houston and New York and has only recently expanded elsewhere (KIPP Lynn is the only KIPP school in New England). In an important sense, therefore, our results help to answer the question of whether this model can be successfully packaged and implemented at new locations. More tentatively, the results may extend to other "No Excuses" schools (a term coined by Carter 2000 and Thernstrom and Thernstrom 2003) using central elements of the KIPP model, including extended instructional hours, selective teacher hiring, strict behavior norms, and a focus on traditional math and reading skills.

[1] A few studies have looked at overall effects of KIPP. See, for example, the studies linked at http://www.kipp.org/01/independentreports.cfm. Hoxby and Murarka (2009), a lottery-based evaluation of charter schools that includes some from KIPP in New York City, does not report KIPP results separately. Our recent AER Papers and Proceedings article (Angrist, *et al.*, 2010) presents a brief overview of some of the results reported here, but does not explore the KIPP schooling model in depth or estimate effects among subgroups that have been at the heart of the charter debate.

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

II. Background

A. The KIPP Context

KIPP was started in Houston and New York City in 1995 by veterans of Teach for America, a program that recruits graduates of elite colleges to teach in low-performing districts (Mathews, 2009). The first KIPP schools operated as alternative programs within traditional public school districts, with KIPP staff employed by the district and covered by its seniority rules and salary schedules. In New York City, KIPP staff were initially covered by the district's collectively bargained union contract. In both Houston and New York, the KIPP founders negotiated with district leadership for limited autonomy in curriculum, staffing, and hours of instruction. This model – negotiated autonomy within a traditional school district – is still followed by a few KIPP schools that operate under contract with a state or district. Today, however, most KIPP schools are charters (Childress and Marino, 2008). KIPP Houston became a charter school in 1998, and KIPP NYC did the same in 1999 (Leschly, 2008).

KIPP has expanded steadily, opening 97 schools in 20 states in 15 years. Most are middle schools, covering grades five through eight. Recently, 15 KIPP high schools and 24 elementary schools have been added to the network, usually attached to a pre-existing middle school. KIPP now serves 27,000 students, mostly low-income minorities who qualify for a free or reduced-price lunch. KIPP is currently the nation's largest CMO.

KIPP schools are characterized by a high level of standardization. The core set of KIPP policies are laid out in an organizational slogan called the "Five Pillars:" High Expectations, Choice and Commitment, More Time, Power to Lead, and Focus on Results.[2] The "High Expectations" pillar reflects KIPP's focus on behavior and discipline. All KIPP students are expected to adhere to a behavioral code which governs comportment within and between classes. KIPP schools use modest financial incentives, distributed weekly, to reward effort and compliance with the code of conduct, as well as completed homework and passing test scores. Paychecks in the form of "K dollars" can be redeemed for items from a school store (notebooks, t-shirts, snacks). Recent experiments suggest that short-term rewards of this form can improve student achievement (Fryer, 2010).

[2]See http://www.kipp.org/about-kipp, accessed April 4, 2011.

The "Choice and Commitment" pillar receives particular emphasis. Enrollment at KIPP is voluntary, and students are expected to commit themselves fully to the KIPP model while they choose to attend. This idea is encapsulated in a contract known as the KIPP "Commitment to Excellence." Parents or guardians, students, and teachers at all KIPP schools are asked to sign this contract, which is a promise to come to school on time, work hard, and complete schoolwork, among other things.

As suggested by the third KIPP pillar, "More Time," KIPP students spend extended time in school, with both a longer school day and a longer academic year than traditional public schools. Much of the additional time is used for instruction in basic math and reading skills. The "Power to Lead" pillar reflects the ability of KIPP principals to respond to idiosyncratic needs at the school level. This includes flexibility in budgetary and staffing decisions. For example, KIPP teachers are typically non-union and employed outside whatever collective bargaining agreement may be in force in the district where the school is located.[3] To implement the fifth pillar, "Focus on Results," KIPP schools use frequent diagnostic standardized tests to measure student progress and identify areas for improvement.

As the number of KIPP schools has grown, the founders have tried to develop and maintain the KIPP brand while still allowing local schools a high degree of autonomy. The current KIPP organization, which resembles a retail franchise, was developed with financial and logistical support from the founders of The Gap, Inc. Central and regional offices train school principals, recruit teachers, and provide operational support. KIPP schools pay a licensing fee to the central organization, amounting to one percent of revenue in the first year of a school's operation and three percent in subsequent years (Leschly, 2003). KIPP retains the right to withdraw the use of its name if it determines that a school is not meeting the network's standards. Between 2001 and 2007, five KIPP schools closed, while two left the KIPP network and continued to operate as independent charter schools (Childress and Marino, 2008).

The KIPP Foundation bears many of the costs of starting a school, scouting out new locations and training new principals. KIPP headquarters also provides operational support in the form of advice on human resources management, legal issues, procurement and budgeting (Leschly, 2008). KIPP principals receive a year of salaried training from KIPP. In 2002, there were 420 applicants for 20 slots in the training program. Principals-in-training spend six weeks at the Haas School at Berkeley, trained by instructors from the business schools at Berkeley and Stanford. They then shadow a principal at an established KIPP school. The remainder of the year is spent preparing their new school. New principals are coached and mentored in the first few years of operation (Leschly, 2003).

[3]There are a few exceptions. Teachers at a KIPP school in Baltimore are covered by a union contract. Three KIPP schools in New York City have also been affiliated with unions at various times, though each subsequently voted to decertify.

B. KIPP Academy Lynn and the Lynn Public Schools

Lynn, Massachusetts is a city of 90,000 located ten miles northeast of Boston. The city was a manufacturing center from its earliest days, with footwear driving the economy until the nineteenth century, when electrical manufacturing took center stage. General Electric's Lynn plant built the country's first jet engines during World War II, and a GE plant is still located in the city. Even in its heyday, the city had a colorful reputation. (A well-known New England ditty begins: "Lynn, Lynn, city of sin, you never come out the way you came in.") Crime rates in Lynn are among the highest in the state. When manufacturing declined, poverty rose and income fell. The city's 2007 poverty rate stood at 21 percent, more than twice the Massachusetts average.

Lynn Public Schools (LPS) enroll about 13,000 students a year in its nineteen elementary schools, four middle schools and five high schools. KIPP Academy Lynn is the only charter school in the city. About 1,600 children, or 11 percent of the school-age population, attend private schools in Lynn. While the population of Lynn is more than two-thirds white, most of the 13,000 schoolchildren in the city are nonwhite. Nearly 80 percent of Lynn's students are eligible for a free or reduced-price lunch. In 2009, all of the city's public schools fell short of the achievement standards laid out in the federal No Child Left Behind (NCLB) act. Middle school students in LPS are failing to meet state standards for adequate yearly progress (AYP) in every subgroup tracked by NCLB. Fifth-grade students in LPS score about a third of a standard deviation below the Massachusetts average on the MCAS, a fact documented in the first column of Table 1, which reports scores of LPS students (relative to the state average) along with other descriptive statistics.

KIPP Academy Lynn, which opened in the Fall of 2004, currently serves about 300 students in grades five through eight. The state recently approved KIPP's request to open a high school in Lynn. KIPP Lynn is governed by a board drawn from the local community. The principal ("school leader") serves at the will of the board. None of the school staff are employed by the national KIPP organization. As at other KIPP schools, the KIPP name is licensed from the national organization, which can revoke the license if it considers the school out of compliance with KIPP goals and standards. KIPP staff attend an annual national conference and participate in the teacher and principal training programs provided by the national organization.

KIPP Lynn shares the core features of the KIPP model described above. It uses the "K dollars" paycheck system to encourage academic effort and compliance with behavioral norms. Students' paychecks serve to keep parents informed of a child's behavior and progress, since a paycheck cannot be cashed until a parent has signed it. The school's 2003 application for charter notes: "While students can earn up to K$50 each week, a minimum of K$35 on their paycheck tells a parent that the student is meeting the minimum behavioral standards required by the school (KIPP Academy Lynn

Charter School, 2003)." Parents, students, and teachers at KIPP Lynn sign the KIPP "Commitment to Excellence." In keeping with the "More Time" principle, KIPP Lynn has a very long school year, starting in August and running on many Saturday mornings. The school day starts at 7:30 am and ends at 5:00 pm. This works out to about 1,900 hours of instruction per year, as compared to about 1,250 in LPS. KIPP Lynn students are also encouraged to call teachers at night with questions about homework.

Consistent with KIPP's focus on measurable results, the school closely tracks students' academic performance. KIPP Lynn students take the Stanford 10, a widely used standardized test, each summer before school starts. These tests are used to assess the curricular needs of a cohort and to plan interventions for individual students. Student performance theroughout the year is discussed in staff meetings. Students are also tested at the end of the year, again with the Stanford 10 (KIPP Academy Lynn Charter School, 2003). The state of Massachusetts tests students in all grades covered by KIPP, using the MCAS. Individual student MCAS scores are not immediately made available to schools, however, which limits their usefulness for planning.

KIPP Lynn's teachers are recruited through the national KIPP organization, which provides a central clearinghouse for teachers interested in teaching at a KIPP school. Resumes are screened and forwarded to KIPP Lynn, which interviews applicants by phone and invites finalists to teach a sample lesson at the school. To fill five teaching slots at KIPP Lynn in 2007, the national organization screened 5,000 resumes and asked 250 applicants to complete a detailed questionnaire. Forty applicants were interviewed by phone and 25 invited to teach a sample lesson (Massachusetts Department of Elementary and Secondary Education, 2008).

Similar to other KIPP schools, many KIPP Lynn teachers are graduates of Teach for America. KIPP Lynn teachers are also much younger than their LPS colleagues: 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). While KIPP Lynn teachers are younger and less likely to be licensed than LPS teachers, they are paid more (and work longer hours): in 2008, average teacher salaries were $69,353 at KIPP Lynn and $60,523 in LPS. The KIPP Lynn and LPS student-teacher ratios are similar, however (around 14), implying that KIPP Lynn spends a higher proportion of its budget on instructional salaries than does LPS. The school employs four full-time special education teachers, as well as a part-time, licensed ELL teacher. Eight staff members are fluent in Spanish (Massachusetts Department of Elementary and Secondary Education, 2008).[4]

[4]Statistics in the paragraph are calculated from data available at http://profiles.doe.mass.edu, accessed January 28, 2010. MA charter school teacher salaries are available at http://finance1.doe.mass.edu/charter. Public school salaries are at http://finance1.doe.mass.edu/statistics/.

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 of the regular public school district. KIPP Lynn spent about $11,500 per pupil in fiscal year 2008, net of rental and capital costs that add another $2,000. KIPP Lynn is currently located in a rented former church. KIPP Lynn receives about $11,000 per pupil from the town of Lynn, with the remaining expenditures covered by donations and grants. Average per pupil expenditure in LPS schools was about $13,000 in 2008. Like all new KIPP schools, KIPP Lynn received substantial logistical support from the KIPP Foundation at startup.[5] As at LPS schools, the state and LPS cover busing costs for transportation-eligible students at KIPP.

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 randomized lotteries allow us to estimate the causal effect of KIPP Lynn on the achievement of applicants, solving the problem of selection bias that plagues most studies of school effectiveness. Only Lynn residents can apply to KIPP Lynn. About three-quarters of KIPP applicants were attending a Lynn public school at the time of application; the balance presumably attended Lynn's Catholic schools or charter schools outside the city. KIPP Lynn applicants have (pre-lottery) math and reading scores that are 0.39σ and 0.44σ below the state average, which is slightly lower than the LPS average (Table 1). About a fifth of KIPP Lynn applicants are designated LEP, while a fifth are categorized as special education students, similar to rates in the Lynn Public Schools.

C. Previous Research

Many studies try to assess the effect of schools on the achievement of low-income, nonwhite students. As suggested by the concerns of Carnoy, *et al.*, (2005), the key challenge in this literature is selection bias: students at different types of schools likely differ in many ways, both observed and unobserved. Catholic schools, which (like charter schools) have traditionally served a low-income, urban student population, have received particularly intense scrutiny. Research on Catholic schools has followed an arc similar to that on charter schools, with initial studies using statistical controls to control for

[5]KIPP Lynn financial statistics are from Massachusetts Department of Elementary and Secondary Education. 2009. "FY2008 Charter School End of Year Financial Report Summary." Available at http://finance1.doe.mass.edu/charter/08CSEOYFR_Summary.xls, accessed May 3, 2010. LPS financial statistics are from Massachusetts Department of Elementary and Secondary Education. 2010. "FY08 Expenditures Per Pupil, All Funds, Summary By Function." Available at http://finance1.doe.mass.edu/schfin/statistics/function08.xls, accessed May 3, 2010.

selection (Coleman, 1966) and more recent research employing instrumental variables methods.[6]

Charter school evaluations that rely on statistical controls to deal with selection bias have produced mixed results. A study using propensity score methods to match charter school students to similar students in nearby traditional public schools concludes that charter schools are no better on average than traditional public schools (CREDO 2009). A recent study of KIPP schools in the Bay Area, which also used a propensity score approach, concluded that test scores are higher at KIPP but cautioned that this may be driven by high exit rates by weaker students (Woodworth, *et. al.*, 2008). We will examine the rate at which KIPP admits switch schools, comparing it to the rate of school switching among those who lose the KIPP lottery. This apples-to-apples comparison indicates that KIPP students are no more likely to switch schools than other public school students.

The few charter evaluations that have used lotteries to identify causal effects report substantial achievement gains. Lottery estimates for middle and high schools in Boston, many of which use the No Excuses model, show test score gains on the order of 0.2 to 0.4 standard deviations for each year a child spends in a charter school (Abdulkadiroğlu, Angrist, Dynarski, Kane, and Pathak, forthcoming). Hoxby and Murarka (2009) find smaller though still substantial effects from a more heterogeneous sample of schools in New York City. A recent national study by Mathematica Policy Research used the lottery approach to evaluate over-subscribed charter schools in several states (Gleason, *et. al.,* 2010). The study's results for urban, high poverty charter schools are similar to those found in Hoxby and Murarka (2009). Dobbie and Fryer (2009) use lottery data to examine two of the Harlem Children's Zone charter schools, with results similar to those we find here for KIPP. However, children in the Harlem Children's Zone receive a barrage of unusually intensive and expensive social services, and the achievement effects may arise in part from these services.

III. Data

A. Admissions Lottery Data

Our sample of applicants is drawn from records of the four lotteries that took place at KIPP Academy Lynn from 2005 through 2008. All charter schools in Massachusetts are required by state law to conduct lotteries if they are over-subscribed. However, the lotteries are run by the individual schools, and there is no centralized repository for the lottery data. KIPP staff graciously granted us full access to the school's paper and electronic lottery records. 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. These records were missing some key

[6] Altonji, Elder and Taber (2005a, 2005b) summarize and critique this literature.

information. In particular, for some applicants, initial lottery status had been over-written with enrollment status. In order to reconstruct the original lottery assignment, we conducted a detailed, student-by-student review of applicant histories with school staff. As we show in the next section, our reconstruction of the lottery data appears to have been successful.

From 2005, 629 students applied to KIPP Academy Lynn. The first five rows of Table A1 summarize the raw applicant data and subsequent restrictions made to the data. If a student applied to KIPP Academy Lynn more than once, only the first application is included in the analysis. We exclude late applicants (who applied after the lotteries), as well as sibling applicants (who are guaranteed entry) and any students who went directly onto the waiting list (these are mostly 6th grade applicants in early cohorts). A few students who repeated grades were listed in the lottery data to remind school staff to reserve an appropriate number of slots, and these students are not included in the analysis sample. Imposing these restrictions reduces the number of applicant records from 629 to 531. Lottery records were used to reconstruct an indicator for whether applicants won the chance to attend KIPP Lynn. Of the 531 applicants, 339 received an offer to attend KIPP Academy Lynn.

B. Attendance, Demographic and Test Score Data

We matched the 531 KIPP Lynn applicants to the Massachusetts Student Information Management System (SIMS), a database with demographic and attendance information for all public school students in the state. We use SIMS data from the 2001-2002 school year through the 2008-2009 school year. 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, subsidized lunch eligibility, and school attended. The SIMS records capture data at multiple points within the school year. If a student is classified as SPED, LEP, or qualified for free/reduced price lunch at any time within a school-year-grade, then he or she is coded that way for the entire school-year-grade record. If we observe a student attending KIPP at least once in a given academic year, we code her as attending for the entire year.

Students in the lottery sample were matched to the SIMS data by name, pre-lottery grade, and year.[7] Our match rate is 95.3 percent among the 73 percent of applicants who were enrolled in the Lynn Public Schools at the time of the lottery (Table A2). For this group, there is no statistically distinguishable difference between the match rates for lottery winners (96.2 percent) and lottery losers (93.4 percent). When we broaden the sample to include any students who were not previously enrolled in the Lynn Public Schools, the match rate is 91 percent, and lottery winners are more likely to be

[7] In some cases, this did not produce a unique match, particularly when 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.

matched to the SIMS than lottery losers (95.3 percent vs. 83.9 percent, respectively).[8] To check whether this differential match rate in the full sample biases our findings, we conduct a separate analysis using only the subsample of LPS applicants. As we show later, we obtain effects very similar to (but less precise than) those produced using the full sample. This suggests that the difference in SIMS match rates between winners and losers does not bias our estimates.

The lottery/SIMS matched sample includes 484 applicants (Table A1). We drop students without baseline (4th grade) demographics in the SIMS, as well as applicants who had completed 6th or 7th grade prior to the lottery, leaving 446 students. In Massachusetts, third through eighth graders take MCAS exams in math and English language arts (ELA), which we normalize to a statewide mean of zero and standard deviation of one by subject, grade and year. We merge the KIPP applicants' SIMS records to the MCAS scores from Spring of 2006 through Spring 2009 using a state student identifier (the SASID), excluding test scores taken by students during repeat grades. If all the applicants maintained normal academic progress in Massachusetts public schools (and therefore took the MCAS) we would expect to find 948 math scores and 948 ELA scores for our sample (Table A3). We find at least one post-lottery test score for 96 percent of applicants scheduled to sit for the MCAS between 2006 and 2009 and 88 percent of expected scores (Table A3).[9] As we show later in the analysis, there is no statistical or substantive difference in the probability that we find MCAS scores for lottery winners vs. losers.

C. The Matched Lottery Sample

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. The number of applicants has risen over time, from 138 in 2005 to 207 in 2008 (Column 4). A total of 629 students applied to KIPP over this period. As detailed in the previous section, 446 of these applicants are both subject to the randomized lottery (e.g., their admission status is not pre-determined by the fact that they are sibling applicants or late applicants) and matched to the state administrative datasets (Column 5). The likelihood of winning admission to KIPP has gone down over time: the share offered a seat at KIPP Lynn dropped from 92.5 to 53.7 between 2005 and 2009 (Column 6). About half of those who apply end up attending

[8] This differential is likely driven by missing SIMS records for those who attend private schools when they apply to KIPP (15 percent of middle-school students in Lynn attend private schools). KIPP staff informed us that many private school applicants who apply to KIPP, but lose the lottery, choose to remain in their schools. Since private school students do not appear in the SIMS, these students would not have a SIMS record.

[9] Among our 446 students in the matched SIMS/lottery data, 38 could not have sat for a post-lottery MCAS exam between 2006 and 2009, due to the grade and year in which they applied to KIPP. We find at least one post-lottery score for 390 of the remaining 408 students, a match rate of 96 percent. It is for these 408 students that we expect to observe 948 scores.

KIPP (Column 7). These offer and attendance rates imply that about 80 percent (=52.5/67.9) of those offered a seat at KIPP take up the offer; this take-up rate has been fairly stable over time.

The last column shows the average number of years spent by each cohort at KIPP Lynn between 2006 and 2009. Across the four cohorts, lottery winners spent an average of 1.85 years at KIPP Lynn as of 2009 (last column of Table 2), but this varies by cohort. As of 2009, the 2008 cohort had spent an average of just 0.7 years at KIPP, and taken just one MCAS exam, in 5th grade in 2009. By contrast, the 2005 cohort had spent an average of 2.6 years at KIPP and had the opportunity to take four MCAS exams (in 5th through 8th grade, in 2006 through 2009). Since we have the most outcome data for the earliest admitted cohorts, the results in the paper should be interpreted as the effect of a relatively new school on its first cohorts of students.

In Table 1, we provide descriptive statistics for the lottery sample (Column 3), including their baseline (4th grade) test scores. To provide context, we also show statistics for all 5th grade students who were enrolled in KIPP Lynn between 2006 and 2009 (Column 2), as well as for students enrolled in 5th grade in Lynn Public Schools during the same period (Column 1). As noted earlier, Lynn's schools are heavily Hispanic (42 percent), Black (17 percent) and low-income (77 percent are eligible for a subsidized lunch). These numbers are even higher for KIPP Lynn students: 57 percent Hispanic, 24 percent Black and 84 percent low-income. These data do not suggest that KIPP students and applicants are positively selected from the Lynn Public Schools. In fact, on nearly every dimension, they appear more disadvantaged than students attending the city's traditional public schools. Lynn's test scores are about a third of a standard deviation below the state average, and those who apply to and attend KIPP have even lower scores when they enter the school. This is typical of poor urban school districts in Massachusetts.[10] Importantly, large fractions of students both in the lottery sample and in Lynn Public Schools are categorized as limited English proficient or special education; roughly one fifth of applicants and one fifth of LPS students fall into each of these groups.[11] In all of the observable characteristics listed in the table, students in our lottery sample are quite similar to students actually enrolled in KIPP.[12]

[10]Scores in Lynn are actually slightly higher than in the Boston Public Schools, where achievement lags behind the state average by more than 0.7σ.

[11]The distributions of student disabilities are also similar among applicants and in LPS. In both groups, the largest category is "specific learning disabilities," which include reading deficits and dyslexia. 12 percent of applicants and 11 percent of LPS students have such disabilities. The remaining SPED students are scattered across a number of different categories, including intellectual, emotional, and health-related disabilities.

[12]There is no reason to expect the two samples would be identical, since they are drawn from populations that differ for two reasons. First, sibling admits (N=47) are included among the enrolled KIPP students but excluded from the lottery sample. Second, students who are admitted to KIPP but do not attend (about 20 percent of admits) are included in the lottery sample but excluded from the enrolled KIPP students. Sibling admits appear similar to those admitted by lottery, with just two statistically significant differences: they are more likely to be poor (92 percent vs 83 percent) and less likely to be black (13 percent vs. 26 percent).

In a randomized lottery, any baseline differences between winners and losers should be small. We test for balance between the lottery winners and losers in Table 1. Column 4 lists differences in demographic characteristics and baseline scores between those who win and lose the KIPP Lynn lottery. Note that all of these background characteristics are based on pre-lottery data. We take care to use pre-lottery data because some variables may by affected by the school a student attends (e.g., categorization as an English learner or special-education student, or signed up for subsidized lunch). We obtain the estimates in Column 4 by regressing the listed characteristics against a dummy indicating that a student was offered admission to KIPP Lynn, as well as a set of dummies indicating year and grade of application (this is the same set of regressors we include in our 2SLS analysis, discussed below). Differences in baseline scores are statistically indistinguishable from zero, as are all but one of the differences in demographics (lottery winners are slightly more likely to be Asian). The F-statistic from a joint test of balance on all observable characteristics produces a p-value of 0.615, indicating that we are unable to reject the null that the means of all baseline characteristics are the same for winners and losers. The small differences we observe in baseline scores shrink yet further when we control for baseline demographics (Column 5), and the p-value on the F-test rises to 0.832.

While Table 1 shows that lottery winners and losers are similar at the time of the lottery, subsequent attrition could produce imbalance in the follow-up sample if the attrition process is non-random. As discussed above, we have merged the lottery data with administrative test score data from the state of Massachusetts. Given the broad coverage of these data, the opportunities for students to atrit from our sample are quite limited. In particular, a student can transfer between KIPP and any another public school in the state without exiting our sample. Only those KIPP applicants who leave Massachusetts or transfer into a private school are lost to follow-up. If those who lose the KIPP lottery are more likely to attrit in this fashion, it could produce bias in our analyses. Selective attrition of this sort has the potential to effectively undo the apples-to-apples nature of comparisons generated by the original randomization.

Table 3 probes for evidence of differential attrition between lottery winners and losers. The outcome of interest is a dummy variable indicating that a given KIPP Lynn applicant has a test score in the dataset for a year and subject in which she was scheduled to be tested. We expect to observe 948 (post-lottery) test scores for students who participate in our applicant lotteries.[13] We find 85 percent of expected scores for those who lost the applicant lottery (Column 1). This is consistent with what we would predict, given that 15 percent of middle-school students in Lynn attend private schools. For lottery winners, the probability we find an expected score is five percentage points higher (Column 2). This difference is not statistically significant, and it shrinks further when we add demographics and

[13] Appendix Table A3 lists the number of test scores expected and observed for each applicant cohort.

baseline test scores to the estimating equation (Columns 3 and 4).

These small differences in attrition are extremely unlikely to explain the very large effects we find in the paper. Assume that the post-lottery test scores of the "missing" lottery losers are a full standard deviation higher than those of the lottery losers who remain in the sample – an extreme degree of selection. In this scenario, differential attrition would explain 0.05σ of our estimated reduced-form effects which, as we show below, are 0.16σ for reading and 0.43σ for math. For attrition to explain these estimates, the test scores of the missing lottery losers would have to be three to nine standard deviations higher than those of the lottery losers who remain in our data. Further, while we obviously cannot examine outcomes for the missing students, we can compare their baseline scores with those of students who remain in our sample. We find that, among those who win the lottery, baseline scores do not differ by attrition status. Among those who lose the lottery, baseline scores are *lower* for those who attrit than for those who remain in the sample. This suggests that, if anything, attrition tends to work against our positive results, by pulling up the scores of lottery losers in our analytic sample.

D. 2SLS Strategy

We model the causal effect of KIPP Lynn attendance on test scores as a function of time spent attending KIPP Lynn, using the equation:

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

Here, 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. If a student spends any time at KIPP in a given school year, we count them as attending KIPP for that full year. This conservative assumption will tend to drive down the magnitude of our 2SLS estimates. We include any repeated grades in our count of years spent at KIPP. 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 of winning a seat at KIPP varies from year to year.[14]

We use randomly-assigned lottery offers as an instrument for s_{igt}. Lottery offers are likely to

[14] All specifications include a dummy indicating whether an applicant's sibling is in the lottery, as well as the interaction of this dummy with year of application. Siblings who apply together are more likely to get in, since having a winning sibling improves the losing sibling's position on the wait list. Note that applicants with siblings *already* enrolled in KIPP are excluded from the analysis sample, since such applicants are guaranteed admission. The applicants who are non-lotteried siblings have similar observable characteristics to lotteried applicants.

satisfy the two classical conditions for a valid instrument: They must affect the amount of time spent at KIPP and be unrelated to unobserved factors that influence test scores. The first-stage equation can be written:

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

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. Specifically, Z_i indicates students offered a seat at KIPP Lynn sometime between the lottery date for the relevant application cohort (usually in March) and the start of the following school year. These offers were determined by randomly-assigned lottery-sequence numbers. The reduced form generated by this two-equation 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

We begin by examining the first stage, which is the effect of winning the lottery on the number of years spent at KIPP Lynn. In a world with perfect lottery compliance, no late entry or grade repetition, no loss to follow-up, and cohorts of equal size, the first stage in our sample would be 1.75.[15] In fact, the first stage is a little over 1.2 years (first column of Table 4). The interpretation of this estimate is that, at the time they sat for each MCAS test, 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 estimate.[16]

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 $0.12-0.18\sigma$ as the set of controls varies. This variation probably reflects the modest imbalance between winners and losers in the proportion LEP (documented in Table 1); we would expect LEP status to be more

[15] We make this calculation as follows. The 2005 cohort contributes one score after one year (in 5^{th}grade), one after two years (in 6^{th}grade), one after three years (in 7^{th}grade), and one after four years (in 8^{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.

[16] We report separate first stages for math and ELA because samples differ slightly by subject, since subjects are tested on different days.

strongly correlated with ELA scores than with math scores. The estimated effect on ELA is marginally significant in models with demographic and baseline score controls, which substantially increase the precision of the estimates.

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.[17] The more modest 2SLS estimates for ELA show per-year gains on the order of $0.1 - 0.16\sigma$. The most precise of these is 0.13σ, estimated in models with demographic and baseline score controls (s.e.=0.058). These effects are remarkably similar to the middle school results in Abdulkadiroğlu *et al.* (forthcoming), which come from a larger sample of charter schools in Boston. 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.[18]

We noted above that the match rate from KIPP Lynn lottery records to SIMS data was almost perfect among students who attended a Lynn public school at baseline. Also significant for our analysis, baseline covariates are almost perfectly balanced across lottery status in this subsample. Therefore, as a robustness check, we report results for the sample of applicants who attended an LPS school at the time they applied. These estimates, shown in columns (5) and (6) of Table 4, are nearly identical to the estimates obtained from the larger sample, but are slightly less precise. This set of results bolsters our confidence that the full-sample results are not driven by differences in match rates or the small differences in covariates between winners and losers that were detected in Table 1.

To provide a sense of whether the KIPP Lynn treatment effect has been increasing over time, Figure 1 plots reduced-form estimates by cohort and grade. The plots start in fourth grade in order to document any baseline differences.[19] 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

[17] As noted by Angrist and Imbens (1995), if the effects of KIPP Lynn are nonlinear in years attended, our 2SLS estimates can be interpreted as a weighted average of the effects of each year.

[18] 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 (4) of Appendix Table A4. The corresponding 2SLS results, reported in column (6) of Table A4, are similar to the 2SLS estimates reported in Table 4.

[19] 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. The estimates are reported in Table A5.

through grades suggests 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. Overall, these figures suggest that KIPP Lynn's achievement effects are cumulative through grades and increasing across cohorts since the school first opened in 2004.

A. Variation in the Effect of KIPP across Subgroups

KIPP Lynn serves more LEP and special education students than the typical charter school in the Northeast, and therefore offers a unique opportunity to look at the effects of charter attendance on these important subgroups. The first four columns of Table 5 show that math gains are somewhat larger for LEP and special education students than among other students. By contrast, reading gains are markedly larger for students in these groups. In fact, the moderate reading gains found earlier in Table 4 (0.12σ) appear to be driven almost entirely by very large gains among LEP students (roughly 0.4σ) and special education students (roughly 0.3σ).[20]

Table 5 also shows separate results for boys and girls. Nationwide, boys lag behind girls on standardized tests, especially in reading and particularly among Blacks and Hispanics.[21] Boys are also more likely to be classified as needing special education services; among Massachusetts 4th graders, 23 percent of boys receive special education services, compared to 13 percent of girls. These gender differences are similar for students at KIPP Lynn. Estimates by gender show math effects that are about the same for boys and girls, as can be seen in columns (5) and (6) of Table 5. On the other hand, consistent with the higher proportion of male special needs students and the results reported here showing larger reading effects in the special education subgroup, the effect of KIPP Lynn attendance on boys' ELA scores is considerably larger than the effect for girls (0.15σ vs. 0.06σ in models with baseline scores).

B. Effects by Baseline Achievement

As noted in the introduction, charter skeptics have argued that even if relatively motivated and able students benefit from charter school attendance, weaker students lose out. If this depiction is accurate, then we might expect KIPP to have benefits that are larger or perhaps even exclusively apparent for those low-income children who are at the upper end of the distribution of academic ability. We explore

[20] Surprisingly, given the difference in effects by LEP status, we find that results are similar for Hispanics and non-Hispanics (see Angrist, *et al.* 2010 for details).

[21] See Lee, Grigg and Donahue (2007) and Figure 3 in Mead (2006).

this type of treatment effect heterogeneity by adding the interaction of baseline (4th grade) scores with years spent at KIPP Lynn to our 2SLS model. The interaction terms are identified in these models by adding an interaction between baseline scores and the lottery offer dummy variable (Z_i in equation 2) to the list of excluded instruments. The interaction terms in these models are normalized so that the main effect of years spent at KIPP reflects the impact of time in KIPP evaluated at the mean of the baseline score distribution. The results of estimation with interaction terms, reported in columns (7-8) of Table 5, suggest that KIPP Lynn raises achievement *more* for weaker students. Specifically, the reading results indicate that children with baseline reading scores half a standard deviation below the KIPP applicant mean get an additional reading boost of about 0.08σ (=-0.5 * -0.167) from each year spent at KIPP, compared to a student whose baseline scores are at the mean. This translates into annual reading gains of 0.16σ per year for the average child at KIPP Lynn (who enters with reading scores 0.4σ below the Massachusetts mean) and annual gains of 0.24σ for a child entering half a standard deviation behind her KIPP classmates (that is, 0.9σ below the Massachusetts mean). Students who enter with the weakest math scores also see a larger math achievement gain from their time at KIPP. The typical KIPP Lynn student experiences math gains of 0.38σ per year, while a student who starts out half a standard deviation behind her KIPP peers realizes annual gains of 0.43σ.

We also looked at the impact of KIPP attendance on the distribution of students across the MCAS proficiency categories that Massachusetts uses to determine whether schools are meeting the AYP standards laid out in federal NCLB legislation. Massachusetts classifies raw MCAS scores in four mutually exclusive categories: Advanced, Proficient, Needs Improvement, and Warning. Under current NCLB provisions, a school is designated as meeting the AYP standard if the school's average score, as well as the average score among various subgroups, falls into the Proficient or Advanced categories. MCAS categories therefore give a simple and policy-relevant picture of the effects of KIPP attendance on the distribution of MCAS scores.

The first row of Table 6 shows the effect of a year spent at KIPP Lynn on the probability a student's score lands him or her in one of the four MCAS categories for math scores. Each year at KIPP is estimated to reduce the probability of falling into the Warning category by ten percentage points, while the probability of performing at an Advanced level rises by ten percentage points. There are no detectable effects in the middle categories. This pattern most likely reflects an across-the-board rightward shift in the distribution of math achievement (since few students are likely to jump all the way from the lowest to the highest category). In contrast, the ELA results show about a 6 point movement away from the Warning group into the Needs Improvement category, with no other change. While the score gains generated by KIPP Lynn are clearly broader for math than for ELA,

it's noteworthy that achievement gains in both subjects reflect a shift out of the lowest group.

This conclusion is reinforced by Panel B of Table 6, which reports effects estimated separately for students from each quartile of the baseline (fourth-grade) score distribution in our sample. The estimates in Panel B show positive and significant effects in all baseline score quartiles for math. In contrast, the only significant ELA effect is for students with the lowest baseline scores. The results in this section show that KIPP Lynn raises the achievement of minority students who start from a very low baseline (the fourth grade scores of KIPP applicants in the lowest baseline quartile are roughly one standard deviation below the Massachusetts average). The results are therefore quite relevant to policy-makers interested in reducing achievement gaps.

C. Are the Results Driven by School Switching?

Can the positive effects reported here be explained by high rates of exit from KIPP? This question is motivated in part by evidence that KIPP schools in the San Francisco area experience 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). It's worth noting in this context that our lottery-based estimation procedure focuses on score differences between winners and losers (i.e., the reduced form effect of winning the lottery) without regard to whether the winners remain in KIPP. Movements out of KIPP by lottery winners therefore reduce the lottery first stage, while leaving the causal interpretation of the IV estimates uncompromised even if the weakest or least motivated KIPP students switch out. On the other hand, if the score gains generated by KIPP come in part from a small but highly motivated group that remains in the school after winning the lottery, while weaker or less-motivated students wash out, selective switching may have a beneficial peer effect that augments effects for those who remain. High exit rates from KIPP might also limit the external validity of our estimates for a broader and perhaps less motivated population.

Our school switching analysis uses the same empirical framework as that used to investigate attrition in Table 3, but the dependent variable in this case indicates whether a KIPP applicant changed schools between grades five and eight. These results, reported in the first column of Table 7, show that KIPP Lynn lottery winners were much *less likely* to change schools than those who lost the lottery. As can be seen in column (2), this difference (and the overall high mean switch rate) can be explained by 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 lottery winners and losers, as can be seen in the last column of Table 7. This implies that KIPP students are no more likely to change middle schools than their LPS peers (in this case, the mean switch rate for both groups is only about 0.08).

V. Concluding Comments

KIPP is a large and growing charter management organization that exemplifies the No Excuses approach to public education. The lottery-based estimates reported here suggest that New England's only KIPP school - KIPP Lynn - has generated substantial score gains for KIPP students, especially those with limited English proficiency, low baseline scores, or in special education. Reading gains are realized almost exclusively by special education and limited English proficiency students. Male and female students appear to have experienced similar achievement gains in math, but reading gains are much stronger for boys. Finally, an analysis of effects on MCAS performance categories shows that KIPP lifts students out of the lowest performance category in both math and ELA. These results suggest that the lowest achievers benefit the most from KIPP attendance. A recent charter study concludes that newly opened charter schools do worse than traditional public schools, with effects that tend to improve as schools age (Zimmer, *et al.*, 2009). It's therefore worth noting that the results reported here are from the first few cohorts to attend KIPP Lynn.

A natural question in this context is how general the lessons learned from a single school can be. Every school has unique features and charter schools are especially diverse, ranging from the highly structured and in many ways quite traditional school environment typical of KIPP to Ohio's virtual charter schools using technology to deliver education to students in their homes. We see the experiences of KIPP Lynn not as definitive for charters as a whole, but rather as revealing important possibilities. Because KIPP Lynn implements the key policies of the highly standardized KIPP model, the estimates reported here are likely to be informative about the effects of KIPP schools at other locations. Our findings suggest the major elements of this replicable schooling model produce substantial achievement gains overall, and especially large gains for relatively weak students and those with special needs.

The results for KIPP Lynn are also relevant to the debate over the proper balance between investment in schools and other community services in policies designed to reduce achievement gaps. A premise of the U.S. Department of Education's recent Promise Neighborhoods Initiative is that achievement gains are more likely when school reform is combined with social, educational, and health support for children from birth to college. An influential proponent of this community-based reform effort is Canada (2010). Others, however, have argued that, at least as far as achievement goes, schools alone may be enough (Curto, Fryer, and Howard, 2010; Dobbie and Fryer, 2009; Whitehurst and Croft, 2010). Our results are consistent with this latter view since KIPP Lynn students receive non-school services typical of those received by children in any urban district.

Would we expect to see similar gains were all schools to adopt the KIPP model? Our estimates show that KIPP has heterogeneous effects, and may have little impact on middle-class children, or on those whose parents are college educated. Moreover, our estimates are relevant for the set of students

who apply to KIPP; effects may be different for students not interested in attending. The general equilibrium effects of KIPP might also differ from partial equilibrium estimates. In particular, the supply of principals and teachers who can execute the KIPP model may be limited. Indeed, KIPP cites the supply of trained principals and teachers as a constraint on growth (Childress and Marino, 2007). To loosen this constraint, KIPP New York has partnered with the Teacher YOU program at Hunter College to design a teacher preparation program that leads to certification and a masters' degree in education (Childress and Marino, 2007). It remains to be seen, however, whether new KIPP schools will be as successful as the one studied here.

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	0.256	0.033	-
				(0.044)	
White	0.296	0.168	0.179	-0.017	-
				(0.040)	
Asian	0.108	0.021	0.022	0.028*	-
				(0.015)	
Female	0.480	0.474	0.489	-0.002	-
				(0.054)	
Free/reduced price lunch	0.770	0.842	0.825	-0.031	-
				(0.041)	
Special Education	0.185	0.189	0.200	-0.009	-
				(0.043)	
Limited English Proficiency	0.221	0.172	0.206	-0.074	
				(0.047)	
Baseline Math Score	-0.307	-0.336	-0.389	0.097	0.034
				(0.114)	(0.107)
Baseline Verbal Score	-0.356	-0.399	-0.443	0.039	-0.036
				(0.119)	(0.105)
F-value from joint test				0.814	0.184
p-value from F-test				0.615	0.832
N for demographics	3964	285	446	446	446
N for baseline Math	3808	284	435	435	435
N for baseline ELA	3805	284	436	436	436

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)-(5) 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 application grade and exclude students with sibling priority and those without baseline demographics. Column (5) adds all of the demographic controls to the regressions for baseline scores. 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	106	0.925	0.670	2.56
2006-2007	2007-2009	5-7	117	86	0.674	0.535	2.29
2007-2008	2008-2009	5-6	167	118	0.627	0.534	1.68
2008-2009	2009	5	207	136	0.537	0.397	0.70
All cohorts	2006-2009	5-8	629	446	0.679	0.525	1.85

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	0.050	0.035	0.039
		(0.032)	(0.031)	(0.030)
		948	948	934
ELA	0.855	0.041	0.025	0.036
		(0.033)	(0.032)	(0.031)
		948	948	935

Notes: Column (1) reports the fraction of test scores found for non-offered students. Columns (2)-(4) report 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 contemporaneous sibling applicant dummy. Column (3) adds demographic variables, and column (4) adds baseline test scores. Samples are restricted to cohorts for which we should observe follow-up scores. 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				Lynn public schools at baseline	
		First Stage	Reduced Form	2SLS	OLS	2SLS	OLS
Subject	Controls	(1)	(2)	(3)	(4)	(5)	(6)
Math	Basic	1.218***	0.437***	0.359***	0.301***	0.352***	0.304***
		(0.065)	(0.117)	(0.096)	(0.048)	(0.110)	(0.054)
		842	842	842	842	683	683
	Demographics	1.225***	0.399***	0.325***	0.312***	0.324***	0.332***
		(0.067)	(0.106)	(0.084)	(0.041)	(0.099)	(0.046)
		842	842	842	842	683	683
	Demographics &	1.221***	0.430***	0.352***	0.314***	0.352***	0.344***
	Baseline Scores	(0.068)	(0.067)	(0.053)	(0.032)	(0.064)	(0.038)
		833	833	833	833	675	675
ELA	Basic	1.218***	0.189	0.155	0.169***	0.224*	0.166***
		(0.065)	(0.118)	(0.096)	(0.049)	(0.115)	(0.057)
		843	843	843	843	684	684
	Demographics	1.228***	0.124	0.101	0.170***	0.159*	0.179***
		(0.068)	(0.098)	(0.078)	(0.041)	(0.092)	(0.046)
		843	843	843	843	684	684
	Demographics &	1.228***	0.164**	0.133**	0.174***	0.150**	0.185***
	Baseline Scores	(0.068)	(0.073)	(0.059)	(0.031)	(0.069)	(0.036)
		833	833	833	833	677	677

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 form, 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 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: Subgroups and Interactions

		Effects by Subgroup						Baseline Score Interaction	
		LEP	Non-LEP	SPED	Non-SPED	Male	Female	Main effect	Interaction term
Subject	Controls	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Math	Demographics	0.618***	0.266***	0.459**	0.285***	0.344***	0.276**	-	-
		(0.205)	(0.093)	(0.207)	(0.088)	(0.112)	(0.126)		
		128	714	173	669	427	415		
	Demographics and Baseline Scores	0.466***	0.314***	0.419***	0.330***	0.336***	0.381***	0.375***	-0.111***
		(0.155)	(0.057)	(0.146)	(0.053)	(0.072)	(0.080)	(0.054)	(0.041)
		127	706	172	661	422	411		833
ELA	Demographics	0.441**	0.022	0.155	0.048	0.158	-0.003	-	-
		(0.189)	(0.085)	(0.199)	(0.079)	(0.105)	(0.115)		
		127	716	174	669	425	418		
	Demographics and Baseline Scores	0.428***	0.061	0.268*	0.063	0.177**	0.056	0.155***	-0.167***
		(0.141)	(0.063)	(0.156)	(0.059)	(0.080)	(0.087)	(0.057)	(0.044)
		126	707	172	661	419	414		833

Notes: Columns (1)-(4) report 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 male 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 male estimation sample includes 205 students, while the female sample includes 196. Columns (7) and (8) report results from models interacting baseline test score with years at KIPP Academy Lynn. Main effects are at the mean. The interaction models are estimated by including the offer dummy interacted with baseline score as a second instrument. Robust standard errors (clustered at the student level) are reported in parentheses.

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

Table 6: Distribution Effects

Subject	Lowest Group (1)	Second Lowest (2)	Second Highest (3)	Highest Group (4)
Panel A. Effects on MCAS Performance Categories				
Math	-0.100***	-0.019	0.016	0.103***
	(0.028)	(0.038)	(0.039)	(0.026)
Fraction in category	0.183	0.319	0.335	0.162
N		856		
ELA	-0.055***	0.068*	-0.005	-0.003
	(0.020)	(0.037)	(0.037)	(0.017)
Fraction in category	0.084	0.350	0.500	0.065
N		856		
Panel B. Effects by Baseline Score Quartile				
Math effect	0.515***	0.434***	0.453***	0.216***
	(0.185)	(0.106)	(0.100)	(0.054)
Mean score by quartile	-0.943	-0.133	0.218	0.755
N	210	216	199	208
ELA effect	0.499***	0.066	0.049	-0.081
	(0.148)	(0.120)	(0.090)	(0.074)
Mean score by quartile	-1.127	-0.383	0.012	0.474
N	210	208	209	206

Notes: Panel A reports 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. Panel B reports 2SLS estimates of test score effects by baseline score quartile (defined by the distribution of 4th grade scores in our sample). Regressions are run separately for each quartile. 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%

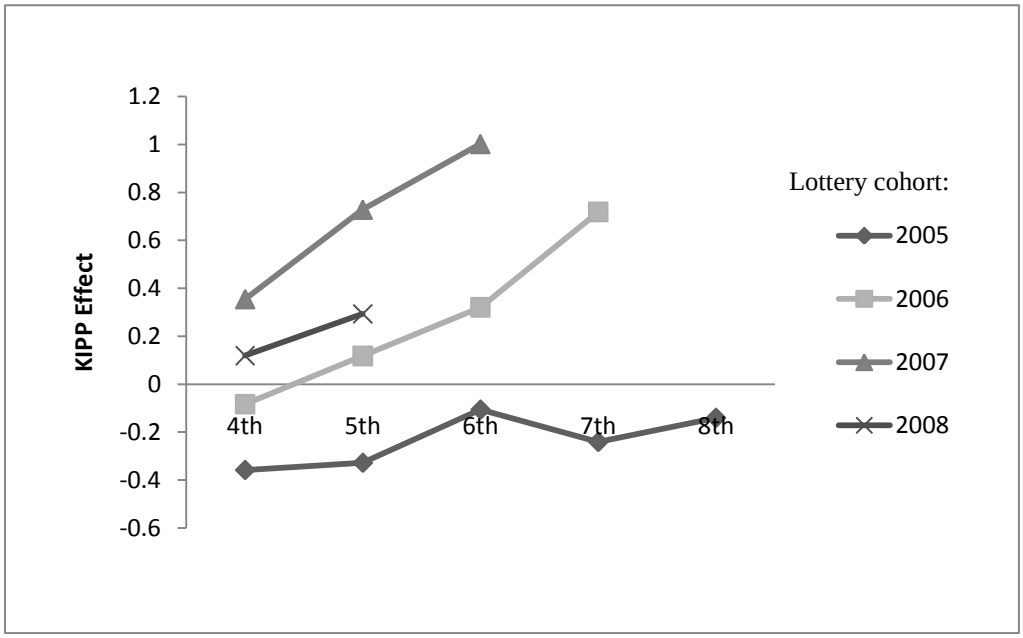
Table 7: School Switching Regressions

	Differential (winner - loser)		
	Any switch	6th grade school is different from 5th	Any switch excluding 5th-6th transition
Controls	(1)	(2)	(3)
Demographics	-0.298***	-0.513***	-0.009
	(0.044)	(0.061)	(0.033)
Mean loser switch rate	0.504	0.855	0.081
	408	284	408
Demographics and Baseline Scores	-0.302***	-0.518***	-0.007
	(0.045)	(0.059)	(0.034)
Mean loser switch rate	0.513	0.853	0.084
	401	281	401

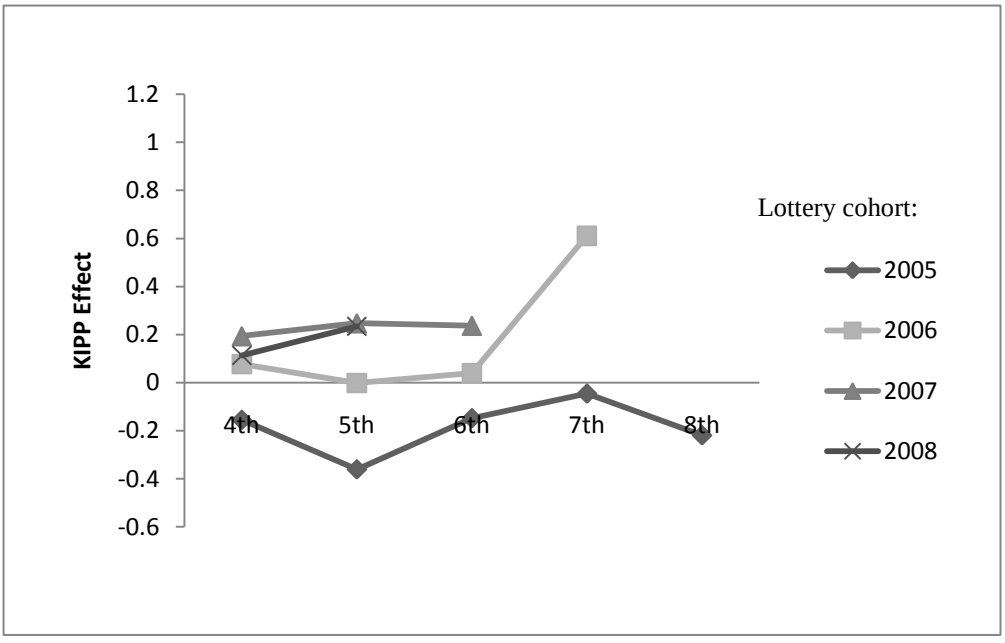
Notes: This table reports coefficients from regressions of an indicator variable equal to one if a student switched schools on an indicator variable equal to one if the student won the KIPP Academy Lynn lottery. The dependent variable in column (1) is 1 if a student ever moves from one observed school to another from 5th to 8th grade, either within a school year or between school years. The dependent variable in column (2) is 1 if a student switches schools between 5th and 6th grade; only observations where both schools are observed are used. The dependent variable in column (3) is 1 if a student switches schools at any time besides the transition from 5th to 6th grade. 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. Sample restricted to 4th grade applicants.

Data Appendix

Data for this project come from KIPP Academy Lynn lottery records, 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 A1 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 531.

Coding lottery offers

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 531 randomized applicants in our lottery sample, 339 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, subsidized lunch eligibility, 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 A2 reports match rates from lottery records to the SIMS/MCAS file. The overall match rate is 91.1 percent (484 students out of 531). The match rate for offered students is 95.3 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 96.2 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 484 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 446 students. This is the sample of students used for the calculations reported in Table 2. Rows 6-8 of Table A1 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.

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 408, eliminating 31 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 948 post-lottery outcomes we could hope to observe for each subject, we found 842 for Math and 843 for ELA; 390 of our 408 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 833 outcomes for both Math and ELA; four students out of 390 lack baseline Math and ELA scores.

Table A.1: 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	121	102	134	174	531
Excluding students not matched to the SIMS	114	95	122	153	484
Excluding students without baseline demographics	109	86	118	143	456
Excluding 6th and 7th grade applicants	106	86	118	136	446
Excluding applicants who should not have a test score	106	86	118	98	408

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.2: 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	121	0.942	0.954	0.833	102	0.971	0.968	1.000
2006-2007	102	0.931	0.971	0.848	76	0.934	0.963	0.864
2007-2008	134	0.910	0.950	0.852	92	0.957	0.967	0.935
2008-2009	174	0.879	0.938	0.828	116	0.948	0.946	0.950
All cohorts	531	0.911	0.953	0.839	386	0.953	0.962	0.934

Notes: This table summarizes the match from the KIPP Academy Lynn lottery data to the SIMS. The sample excludes repeat applicants, late applicants, and siblings. Columns (1)-(4) report statistics for all other 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.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	106	104	401	353	357
2006-2007	86	84	238	212	211
2007-2008	118	113	211	188	186
2008-2009	98	89	98	89	89
All cohorts	408	390	948	842	843

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)	(4)	(5)	(6)
Math	Basic	1.218***	0.437***	0.359***	0.681***	0.209***	0.308***
		(0.065)	(0.117)	(0.096)	(0.040)	(0.064)	(0.089)
		842	842	842	842	842	842
	Demographics	1.225***	0.399***	0.325***	0.683***	0.188***	0.275***
		(0.067)	(0.106)	(0.084)	(0.040)	(0.057)	(0.078)
		842	842	842	842	842	842
	Demographics & Baseline Scores	1.221***	0.430***	0.352***	0.684***	0.235***	0.343***
		(0.068)	(0.067)	(0.053)	(0.040)	(0.038)	(0.052)
		833	833	833	833	833	833
ELA	Basic	1.218***	0.189	0.155	0.682***	0.084	0.123
		(0.065)	(0.118)	(0.096)	(0.039)	(0.060)	(0.087)
		843	843	843	843	843	843
	Demographics	1.228***	0.124	0.101	0.685***	0.053	0.077
		(0.068)	(0.098)	(0.078)	(0.040)	(0.048)	(0.067)
		843	843	843	843	843	843
	Demographics & Baseline Scores	1.228***	0.164**	0.133**	0.686***	0.097**	0.142***
		(0.068)	(0.073)	(0.059)	(0.040)	(0.038)	(0.054)
		833	833	833	833	833	833

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%

Table A.5: Reduced Forms by Grade and Cohort

Subject	Test Grade	2005 Cohort	2006 Cohort	2007 Cohort	2008 Cohort	All Cohorts
Math	4th	-0.358	-0.083	0.355	0.119	0.137
		(0.241)	(0.256)	(0.227)	(0.187)	(0.120)
		83	65	101	97	346
	5th	-0.328	0.118	0.728***	0.293	0.336***
		(0.242)	(0.228)	(0.229)	(0.182)	(0.119)
		83	65	95	90	333
	6th	-0.106	0.320	1.002***	-	0.607***
		(0.219)	(0.259)	(0.218)		(0.153)
		79	61	86		226
	7th	-0.241*	0.718***	-	-	0.653***
		(0.146)	(0.231)			(0.200)
		77	54			131
	8th	-0.140	-	-	-	-0.124
		(0.160)				(0.151)
		62				62
ELA	4th	-0.155	0.077	0.194	0.113	0.125
		(0.224)	(0.202)	(0.212)	(0.198)	(0.112)
		83	65	101	98	347
	5th	-0.361	-0.002	0.247	0.234	0.136
		(0.173)	(0.213)	(0.242)	(0.193)	(0.119)
		82	64	93	90	329
	6th	-0.148	0.040	0.237	-	0.128
		(0.300)	(0.237)	(0.223)		(0.142)
		80	61	86		227
	7th	-0.046	0.611***	-	-	0.517***
		(0.156)	(0.206)			(0.177)
		78	54			132
	8th	-0.219	-	-	-	-0.209
		(0.223)				(0.227)
		63				63

Notes: This table reports coefficients from regressing test scores on a full set of application cohort*test grade dummies interacted with the lottery offer dummy. The "all cohorts" coefficients are produced from regressions interacting grade dummies with the lottery offer dummy. Basic and demographic controls are included in all regressions. Sample is restricted to 4th grade applicants. Standard errors are clustered at the student level.
* significant at 10%; ** significant at 5%; *** significant at 1%

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