

# **CHARTER SCHOOLS AND STUDENT ACHIEVEMENT IN FLORIDA\***

by

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I utilize longitudinal data covering all public school students in Florida to study the performance of charter schools and their competitive impact on traditional public schools. Controlling for student-level fixed effects I find achievement initially is lower in charters. However, by their second year of operation new charter schools reach a par with the average traditional public school in reading. By their fourth year of operation they are even with the average traditional public school in mathematics achievement as well. Among charters, those targeting special education students demonstrate lower student achievement while charter schools managed by for-profit entities perform no differently on average than charters run by non-profits. Controlling for pre-existing traditional public school quality, competition from charter schools is associated with improved math and reading scores in nearby traditional public schools.

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## **I. Introduction**

The efficacy of publicly funded school-choice programs have been fiercely debated in recent years. Proponents claim that school choice will not only provide a mechanism for students seeking to improve the quality of their own education but also engender competition that will lead to improvements in the quality of education for students who remain in traditional public schools. Those opposed to publicly-funded school choice argue such programs will skim the best students, drain resources away from public schools and promote racial/ethnic segregation.

While much attention has been paid to voucher programs in Milwaukee, Cleveland and elsewhere, by far the more common vehicle for school choice is charter schools. A total of 41 states have enacted charter-school laws and approximately 685,000 students attended charters during the 2002/2003 school year.<sup>1</sup> Like vouchers, charter schools represent a subsidized alternative to traditional public schools. Students are not charged any tuition and charter schools rely on public funding for their operating budget. While the specifics vary across states, charter schools typically are not subject to many of the regulatory constraints governing traditional public schools; charters generally have considerable freedom in personnel and curriculum decisions.

In this paper I utilize a new longitudinal data base from Florida to address three key issues relating to charter schools and student achievement. First, how does the impact of charter schools on student achievement compare with traditional public schools? Second, to the extent that student performance varies among charter schools, what factors contribute to the difference

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<sup>1</sup>National data on charter school laws and enrollment are from The Center for Education Reform ([www.edreform.com](http://www.edreform.com)).

in performance? Third, what competitive impact, if any, do charter schools have on traditional public schools?

To empirically analyze these issues I will focus on student achievement in traditional public schools and charters in Florida. Due to the size of its charter sector and the availability of data, Florida is an ideal laboratory for empirical analysis of charter schools. Charter schools have existed in Florida since the 1996/1997 school year, when five schools began operation (see Table 1). The number of charter schools has rapidly grown to over 220 in the 2002/2003 school year. Florida now ranks third among the states in number of charters operating and the 51,000 students enrolled in Florida charter schools in 2002/2003 comprise 7.4 percent of the national total.<sup>2</sup> Florida also possesses one of the most comprehensive systems in the nation for tracking student achievement; all public school students (both those in traditional and charter schools) must take annual standardized tests in each of grades 3-10.

I begin by reviewing the extant empirical literature on charter schools in the next section. In the third section I discuss methodological issues and present an empirical model of student achievement. This is followed by a description of the Florida data and the presentation of the empirical results. A final section summarizes the findings and their implications for policy.

## **II. Previous Literature**

### *A. Achievement in Charter Schools*

Despite the size and importance of the charter school movement, quantitative analysis of the impact of charter schools on student achievement has been limited. Much of the existing research lacks sufficient controls for student characteristics which creates potential selection-bias

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<sup>2</sup> Florida charter-school enrollment data for 2002-2003 were provided by the Charter School Accountability Center at Florida State University.

problems due to the nonrandom assignment of students between charters and traditional public schools. However, a handful of recent papers account for the impact of student characteristics on achievement in charter schools by employing longitudinal data and estimating student-level fixed effects models.

Solomon, Paark and Garcia (2001) analyze scores on the Stanford Achievement Test (SAT-9) for a panel of Arizona students in grades 3-11 over the 1998-2000 period.<sup>3</sup> Their 3-year panel encompasses 40,000 total students, including 8,000 students who attended an Arizona charter school at least one year. Their models incorporate fixed-effects to control for time-invariant student characteristics but do not include lagged test scores to account for the cumulative effects of past educational inputs.<sup>4</sup> They find the first-year effect of attending a charter school on achievement is statistically insignificant for both reading and math. However, students who attend a charter school for two or three years experience achievement gains in both reading and math that exceed those of traditional public school students. Unfortunately, no measure of the age of charter schools is included in their analysis. Thus the measured student tenure effects may in part reflect differences in the maturity of charter schools, rather than the duration of charter school attendance.

Hanushek, Kain and Rivkin (2002) analyze individual student achievement gains for four cohorts of Texas students in grades 4-7 during the years 1996 through 2001. Their sample includes over 6,600 students who attended a charter school during the period and more than

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<sup>3</sup>Solomon and Goldschmidt (2004) re-analyze the same data, limiting their analysis to reading scores. Employing a three-level hierarchical linear model they find that students attending charter schools three straight years experience higher achievement growth than students enrolled only in traditional public schools. However, students who start in a charter school and switch to a traditional public school have significantly higher achievement growth than those who stay in charter schools. Further, the positive effects of charter attendance diminish with the grade level; achievement growth for charter-only students exceeds that of traditional-school-only students in elementary school, is equal by middle school and lower in high school.

<sup>4</sup>The inclusion of lagged test scores to control for past educational inputs is discussed in more detail in the methodology section below.

800,000 students in total. Academic achievement is measured by year-to-year changes in standardized individual scores on the Texas Assessment of Academic Skills (TAAS), a criterion referenced test. In addition to student-level fixed effects, their model includes controls for both charter school age and student mobility.

Hanushek, Kain and Rivkin find that student achievement gains in both math and reading are lower in first-year charters than the average traditional public school. These negative effects diminish rapidly as the charters mature, however. For students in charters that have existed three years or more there are no statistically significant differences in reading or math achievement gains relative to peers attending traditional public schools. These average effects mask the wide variation in quality among both charters and traditional public schools, however. Hanushek, Kain and Rivkin split their sample into geographic regions and include school-level fixed effects to measure differences in school quality. They find that higher quality charter schools are often as good or better than traditional public schools but the bottom quartile of charters are of much lower quality than the lowest quartile of traditional public schools in nearly all regions of Texas.

Booker, et al. (2004) also analyze achievement score gains in Texas, though with a larger data set of six cohorts that spans 1995 through 2002 and covers 10,000 charter students and 1.4 million students in total.<sup>5</sup> In addition to controls for charter school age and student mobility, they also include school-level demographics to account for school-wide peer effects. Similar to Hanushek, Kain and Rivkin, they find new charter schools produce lower achievement gains in both math and reading than the average traditional public school and the relative performance of

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<sup>5</sup>Two of the study's authors previously conducted a study of Texas charter schools (Gronberg and Jansen (2001)) which covered only three years and fewer than 1,000 charter students. This prior paper finds students in charter schools do not perform as well on the TAAS exam as do traditional public school students. However, students attending charters primarily serving "at-risk" students outperform students in traditional public schools with similar characteristics. These estimates may be biased, however, since Gronberg and Jansen include the lagged test score as an explanatory variable in their model, but ignore the correlation between the lagged score and the error term and estimate the models using ordinary least squares.

charters improves over time. However, while Hanushek, Kain and Rivkin find that charters in operation three or more years are on par with the average traditional public school, Booker, et. al. estimate that Texas charters in operation six years or more surpass the performance of traditional public schools. This effect must be viewed with caution, however, since it is based on achievement gains of at most 256 students.<sup>6</sup>

Bifulco and Ladd (2004) analyze achievement data for students in North Carolina over the period 1996-2002. Their dataset tracks 5 cohorts of students from grade 3 through grade 8. Their sample includes 496,000 students in total, 8,700 of which attended a charter school at least one year. Of the 8,700 students who attended a charter about 5,700 are observed in both traditional and charter schools. They adopt the same methodology as Hanushek, Kain and Rivkin but obtain some contrary results. Like Hanushek, Kain and Rivkin, they find that students attending brand-new charters have lower test-score gains in both reading and math than students in the average traditional public school. Similarly, they find the negative charter effects tend to diminish as charters mature. However, unlike Hanushek, Kain and Rivkin's results for Texas, Bifulco and Ladd find that in North Carolina the negative impact of charter schools on student achievement gains is statistically significant and quantitatively substantial even for schools in operation for five years.

The recent studies by Hanushek, Kain and Rivkin, by Booker, et. al., and by Bifulco and Ladd are laudable for their application of fixed-effects modeling techniques to relatively large panels of individual student data. However, their focus on the average effects of charter schools on student achievement does little to explain *why* charter schools perform better or worse than

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<sup>6</sup>Booker, et. al. also estimate models that allow for different transition costs of moving from traditional public schools to charters vis-a-vis movement between traditional public schools. In this specification the negative first-year charter effect becomes insignificant. However, since most first-year charters are populated by students switching from traditional public schools to charters the insignificant measured impact of first-year charter schools could simply be due to multicollinearity.

traditional public schools. Likewise, although Hanushek, Kain and Rivkin document large quality variation among charter schools, neither they nor Bifulco and Ladd or Booker, et. al. analyze characteristics of charter schools, other than age and student mobility, that determine charter school performance.

*B. The competitive effects of charter schools*

Advocates of charter schools claim that charters will not only provide a superior education to the students who enroll in them but will also foster competition which will lead to increases in the quality of traditional public schools. A number of authors, including Bettinger (1999), Eberts and Hollenbeck (2001), Greene and Forster (2002) and Holmes, DeSimone and Rupp (2003), have attempted to test this claim by making cross-sectional school-level comparisons. Their results are generally quite mixed, ranging from large positive competitive effects in some instances to small or statistically insignificant competitive impacts in others. Hoxby (2003) also employs school-level data, but compares traditional school performance before and after the introduction of charter school competition. Defining the competitive threshold as a district-wide six percent charter school enrollment share, she finds that in both Arizona and Michigan charter competition boosts traditional public school achievement score levels in both math and reading in fourth grade as well as increasing seventh grade math scores.

Two recent studies, Holmes (2003) and Bifulco and ladd (2004), exploit student-level data from North Carolina to estimate the impact of charter-school competition on academic achievement in traditional public schools. Holmes uses cross-sectional student-level data over multiple years with controls for student race/ethnicity and gender. A student's prior school inputs are measured by a cubic form of the previous achievement score while school-level fixed effects capture any time-invariant attributes of each school. He finds mixed results for more narrow

market definitions; the existence of one or more charter schools within 10 kilometers is correlated with higher scores in math but not in reading while the existence of a charter within 20 kilometers has the opposite effect, higher reading scores but unchanged math scores. When competition is measured at the county level, however, he finds the existence of a charter is associated with higher test scores for traditional public schools in both math and reading.

Bifulco and Ladd perform an analysis similar to Holmes, but possess panel data on individual students and can thus fully account for both time invariant student and school characteristics via fixed effects. In contrast to Holmes, Bifulco and Ladd find no significant effect of charter school competition on traditional public school performance. Neither the existence of one or more charters within 2.5 miles, 2.5 to 5.0 miles or 5 to 10.0 miles has any statistically significant effect on test score gains of students in traditional public schools in North Carolina. Similarly, variation in the number of charter schools within 5 miles of a traditional public school does not have a significant effect on the average traditional public school's performance.

### **III. Econometric Model**

Following Todd and Wolpin (2003), consider a general cumulative model of student achievement:

$$(1) A_{it} = A_t[\mathbf{F}_i(t), \mathbf{S}_i(t), \mu_{i0}, \varepsilon_{it}].$$

$A_{it}$  is the achievement level for individual  $i$  at the end of their  $t^{\text{th}}$  year of life,  $\mathbf{F}_i(t)$  is a vector of family/parental inputs supplied during age  $t$ ,  $\mathbf{S}_i(t)$  is a vector of school-supplied inputs during age  $t$ ,  $\mu_{i0}$  is a composite variable representing individual time-invariant characteristics (eg. innate

ability), and  $\varepsilon_{it}$  captures any measurement error.  $\mathbf{F}_i(t)$  and  $\mathbf{S}_i(t)$  represent the entire input histories of family and school inputs, respectively.

If we assume that the cumulative achievement function,  $A_t(\cdot)$ , does not vary with age<sup>7</sup> and is additively separable, then we can rewrite the achievement level at age  $t$  as:

$$(2) A_{it} = \alpha_1 \mathbf{F}_{it} + \alpha_2 \mathbf{F}_{it-1} + \dots + \alpha_t \mathbf{F}_{i1} + \beta_1 \mathbf{S}_{it} + \beta_2 \mathbf{S}_{it-1} + \dots + \beta_t \mathbf{S}_{i1} + \gamma_t \mu_{i0} + \varepsilon_{it}$$

where  $\alpha_1$  and  $\beta_1$  represent the vectors of weights given to contemporaneous family and school inputs,  $\alpha_2$  and  $\beta_2$  the weights given to last year's inputs and so on.

Estimation of equation (2) requires data on both current and all prior family and school inputs. However, administrative records contain only limited information on family characteristics and no direct measures of parental inputs. Therefore I assume that family inputs are constant over time and are captured by a student-specific fixed component,  $\phi_i$ . The marginal effect of these fixed parental inputs on student achievement may vary over time and is represented by  $\kappa_t$ . This of course implies that the level of inputs selected by families does not vary with the level of school-provided inputs a child receives. For example, it is assumed that parents do not systematically compensate for low-quality schooling inputs by providing tutors or other resources.<sup>8</sup> Given these assumptions the achievement-level equation becomes:

$$(3) A_{it} = \beta_1 \mathbf{S}_{it} + \beta_2 \mathbf{S}_{it-1} + \dots + \beta_t \mathbf{S}_{i1} + \kappa_t \phi_i + \gamma_t \mu_{i0} + \varepsilon_{it}$$

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<sup>7</sup>This assumption implies that the impact of an input on achievement varies with the time span between the application of the input and measurement of achievement, but is invariant to the age at which the input was applied. Thus, for example, attending a private school in kindergarten has the same effect on achievement at the end of third grade as does attending a private school in second grade on fifth-grade achievement.

<sup>8</sup>For evidence on the impact of school resources on parental inputs see Houtenville and Conway (2003) and Bonesrønning (2004).

The need for data covering the entire school input history can be avoided if one is willing to assume that the marginal impacts of all prior school inputs decline geometrically with the time between the application of the input and the measurement of achievement at the same rate, ie.  $\beta_2=\lambda\beta_1$ ,  $\beta_3=\lambda^2\beta_1$ ,  $\beta_4=\lambda^3\beta_1$ , etc. The achievement equation can then be expressed as:

$$(4) A_{it} = \beta_1 S_{it} + \lambda\beta_1 S_{it-1} + \dots + \lambda^{t-1}\beta_1 S_{i1} + \kappa_t \phi_i + \gamma_t \mu_{i0} + \varepsilon_{it}$$

Taking the difference between current achievement and  $\lambda$  times prior achievement yields:

$$(5) A_{it} - \lambda A_{it-1} = [\beta_1 S_{it} + \lambda\beta_1 S_{it-1} + \dots + \lambda^{t-1}\beta_1 S_{i1} + \kappa_t \phi_i + \gamma_t \mu_{i0} + \varepsilon_{it}] - [\lambda(\beta_1 S_{it-1}) + \lambda(\lambda\beta_1 S_{it-2}) + \dots + \lambda(\lambda^{t-2}\beta_1 S_{i1}) + \lambda\kappa_{t-1} \phi_i + \lambda\gamma_{t-1} \mu_{i0} + \lambda\varepsilon_{it-1}]$$

Collecting terms, simplifying and adding  $\lambda A_{it-1}$  to both sides produces:

$$(6) A_{it} = \beta_1 S_{it} + \lambda A_{it-1} + (\kappa_t - \lambda\kappa_{t-1})\phi_i + (\gamma_t - \lambda\gamma_{t-1})\mu_{i0} + \varepsilon_{it} - \lambda\varepsilon_{it-1}$$

Assuming the impact of parental inputs on achievement,  $\kappa_t$ , and the effect of the initial individual endowment on achievement,  $\gamma_t$ , change at constant rates then  $(\kappa_t - \lambda\kappa_{t-1})$  and  $(\gamma_t - \lambda\gamma_{t-1})$  can be expressed as constants,  $\kappa$  and  $\gamma$ . Combining the family/parental inputs with the initial individual endowment into a single component yields:

$$(7) A_{it} = \beta_1 S_{it} + \lambda A_{it-1} + v_i + \eta_{it}$$

where  $v_i = \kappa\phi_i + \gamma\mu_{i0}$  and  $\eta_{it} = \varepsilon_{it} - \lambda\varepsilon_{it-1}$ . In this so-called "value-added" specification the current achievement level is a function of current school inputs, lagged achievement and an individual-specific fixed effect.<sup>9</sup>

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<sup>9</sup>It is important to recognize that I am modeling achievement levels, not achievement growth. An achievement growth model would take the form  $\Delta A_{it} = \pi S_{it} + \lambda \Delta A_{it} + \psi_i + \omega_{it}$  and its estimation would require four continuous years of achievement data.

Education researchers typically estimate a restricted form of the value-added specification where the gain in student achievement from one year to the next (the "gain score") is a function of contemporaneous inputs and an individual-specific fixed effect (see, for example, Hanushek, Kain and Rivkin (2002), Bifulco and Ladd (2004)):

$$(8) A_{it} - A_{it-1} = \Delta A_{it} = \beta_1 \mathbf{S}_{it} + \nu_i + \eta_{it}$$

This of course imposes the restriction that  $\lambda=1$  in equation (7).<sup>10</sup> As noted by Boardman and Murnane (1979) and Todd and Wolpin (2003), this implies that the effect of each input must be independent of when it is applied. In other words, school inputs each have an immediate one-time impact on achievement that does not decay over time. For example, the quality of a child's kindergarten must have the same impact on their achievement at the end of age 5 as it does on their achievement at age 18.<sup>11</sup>

In order to determine the impact of charter schools on educational achievement I utilize the value-added model, equation (7). Estimation of this model by ordinary least squares is problematic, however. The lagged achievement score regressor,  $A_{it-1}$ , will obviously be correlated with the lagged measurement error,  $\varepsilon_{it-1}$ , and thus ordinary-least-squares (OLS) estimates of equation (6) will be biased. In order to obtain unbiased parameter estimates I employ the dynamic panel data estimator developed by Arrelano and Bond (1991). The Arrelano and Bond model uses twice (and greater) lagged levels of the dependent variable as instruments for the lagged difference in the dependent variable in order to eliminate the correlation between the

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<sup>10</sup>Alternatively, equation (8) can be interpreted as a special case of an achievement *growth* model, ie.  $\Delta A_{it} = \pi \mathbf{S}_{it} + \lambda \Delta A_{it} + \psi_i + \omega_{it}$ , where  $\lambda$  equals zero (achievement growth is independent of past school inputs).

<sup>11</sup>Krueger (1999) makes a similar point and provides empirical evidence that class size reduction has the greatest impact on achievement the first year a student is in a small class.

lagged dependent variable and the error term. Asymptotic standard errors are utilized that are robust to general heteroskedasticity over individuals and over time.

In order to provide a comparison to other studies I will also estimate the restricted value-added model specified in equation (8). The obvious disadvantage of this model is the restriction on the decay rate of prior school inputs,  $\lambda$ . This model does have the advantage, however, that it can be estimated by OLS since there is no lagged dependent variable on the right hand side of the equation. Robust standard errors are obtained with the Huber-White estimator.

Variation in school inputs,  $S_{it}$ , will be measured by student mobility (changing schools between academic years and within academic years), the general category of school attended (traditional public or charter) and the type of charter attended (eg. whether it targets a specific student population or not, whether it is run by a non-profit organization or a for-profit management firm and whether it is a conversion from a traditional public school or a school that began *de novo*). Thus any estimated differences between charter and traditional public schools will represent the combined effects of differences in all other school inputs (teacher quality, class size, curriculum, etc.).

## **IV. Data and Results**

### *A. Data*

The Florida Department of Education's Education Data Warehouse maintains longitudinal records on all Florida public-school students, from pre-school through college, beginning with the 1995/1996 school year. The Data Warehouse includes not only test scores and student demographic data, but information on enrollment, attendance, disciplinary actions and participation in exceptional student education and limited English proficiency programs.

Although student records are available since the 1995/1996 school year, statewide standardized testing did not begin in Florida until school-year 1997/1998. In that year students began taking the “Sunshine State Standards” Florida Comprehensive Achievement Test (FCAT-SSS). This is a criterion based exam designed to test for the skills that students must achieve at each grade level in order to be promoted and to eventually graduate from high school. The FCAT-SSS was administered in selected grades from 1997/1998 through 1999/2000 and has been administered in grades 3-10 since the 2000/2001 school year. Beginning with the 1999/2000 school year a second test, the FCAT Norm-Referenced Test (FCAT-NRT) has been administered to all 3<sup>rd</sup> through 10<sup>th</sup> graders. The FCAT-NRT is a version of the SAT-9 achievement test used throughout the country. The FCAT-NRT scores are scaled so that a one-point increase in the score at one place on the scale is equivalent to a one-point increase anywhere else on the scale.<sup>12</sup> The Stanford-9 is a vertically scaled exam, thus scale scores typically increase with the grade level. I use FCAT-NRT scale scores in all of the subsequent analysis. In addition to providing three continuous years of data, use of the FCAT-NRT minimizes potential biases associated with "teaching to the test," since all school accountability standards, as well as promotion and graduation criteria in Florida are based on the FCAT-SSS, rather than the FCAT-NRT.

### *B. Characteristics of students in charter schools*

Table 2 provides a breakdown of student characteristics for both traditional and chartered public schools. The characteristics of students attending charter schools in Florida are quite similar to those of students in traditional public schools. Except for a somewhat lower proportion of students from low-income households (as indicated by free/reduced-price lunch receipt)

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<sup>12</sup>The use of scale scores to evaluate student achievement is important since a one-unit change has the same meaning for low- and high-achieving students. Other types of measures, such as standard deviations from the mean score are potentially problematic; it is not clear that a 0.1 standard deviation increase in a test score, starting one standard deviation from the mean, is the same as a 0.1 standard deviation increase for someone with an initial score equal to the sample mean.

and a somewhat higher enrollment of black students there is little difference in the measured characteristics of students attending charters versus traditional public schools in Florida. Thus, at least at an aggregate level, there appears to be no strong evidence that charter schools "cream" the best students from traditional public schools.

### *C. Student achievement in charter schools*

Estimation of the value-added and restricted-value-added models with individual fixed effects require a minimum of three consecutive years of achievement score data. Thus my analysis focuses on the sample of Florida public school students in grades 3-10 in 2001/2002 who took the FCAT-NRT and who also took the FCAT-NRT in each of the two previous school years.<sup>13</sup> This initial sample includes over 872,000 students, more than 18,000 of which attended a charter school in one or more of the three sample school years. Since the parameters in fixed effects models are identified by within-student inter-temporal variation, transitions between charters and traditional public schools are key to the analysis. Table 3 provides a breakdown of the enrollment patterns of students and indicates nearly 15,000 students in the sample switched between traditional public schools and charters -- substantially more than in any previous study of charter school performance.

Table 4 presents estimates of the average effect of charter schools on student achievement in both math and reading. The results indicate that student achievement in the average charter school is 1.5 to 1.8 scale score points lower in math than the average traditional public school. In contrast, there are no significant differences in reading achievement between the average charter and average traditional public school. The size of the math achievement differential depends on the basis for comparison. In terms of cross-sectional differences among

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<sup>13</sup>The sample includes students who repeat a grade as well as those making a normal one-grade progression from year to year. Separate grade-level dummies are included in the models for grade repeaters.

students, the differential is not very large; the estimated scale score differential in math is equivalent to three to four percent of the standard deviation in all math scores, which equals 48. However, if one compares the average-charter achievement differential to the average year-to-year math score gain, the difference is more substantial, equivalent to nine to eleven percent of the average 17 point year-to-year gain in math.

The effects of student mobility on achievement are captured by three variables: *Number of Schools*, *Structural Move*, and *Non-structural Move*. The first variable, *Number of Schools*, measures the number of schools a student attended during the current school year, thereby controlling for within-year mobility.<sup>14</sup> The second and third variables identify two kinds of between-year school transitions. Following Hanushek, Kain and Rivkin, structural moves are defined as situations where a student moves from one school to another and at least 30 percent of his fellow students in the same grade at the initial school move to the same school. Thus the variable *Structural Move* captures the effects of normal transitions from elementary to middle and middle to high school as well as the impact of significant school rezonings. Correspondingly, the *Non-Structural Move* variable represents students who attend a school different from the one attended at the end of the preceding school year but are not joined by at least 30 percent of their former schoolmates. This encompasses family relocations as well as movements between schools to attend "magnet" or other specialized programs. Consistent with the findings of other researchers, all of the mobility measures have significant negative effects on student achievement with structural moves being more harmful to student learning than non-structural moves.

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<sup>14</sup>Only schools attended two weeks or more are counted. For example, a student who normally attends a single school but is temporarily assigned to a juvenile-justice school for a short duration and then returns to his regular school is counted as attending one school.

It is also interesting to note that the maintained assumption of the restricted value-added model, that the effect of past school inputs doesn't decay (ie.  $\lambda=1$ ), is not supported by the data.<sup>15</sup>

Estimates from the unrestricted value-added model indicate a value for  $\lambda$  of 0.23 in reading and 0.06 in math.<sup>16</sup>

The results in Table 4 mask the important effects of maturation on charter school performance. As previous studies have demonstrated, one would expect that performance improves as charter schools age and become better established. The important issue is how charter schools compare to traditional public schools in the long run. To address this question I estimate two models: one with a linear age trend in charter school performance and another with separate effects for first-year, second-year and third-year charters and traditional public schools.<sup>17</sup>

In the linear-trend model charter age is defined as the number of prior school years the school has been in operation so the age of charters in their first school-year of operation is zero. Estimates of these two models are presented in the upper and lower panels, respectively, of Table 5.

Both sets of model estimates presented in Table 5 indicate that student achievement in math is lower, on average, in brand-new charter schools than in traditional public schools. The value-added models indicate math test scores are 1.4 to 1.9 points (8 to 11 percent of annual gain) lower in first-year charters while the restricted-valued-added models yield somewhat

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<sup>15</sup>I also directly estimated the cumulative function specified in equation (3). The effects of lagged charter school attendance and lagged intra-year and between-year school changes also suggest a value of lambda less than one.

<sup>16</sup>The first-stage estimation of the lagged dependent variable in the value-added model yielded  $R^2$  values of 0.23 for reading and 0.13 for math. I also estimated value-added models with twice-lagged levels of student attendance, retention and disciplinary incidents as additional instruments. The results differed little from those presented in Table 4 and a Sargan test rejected the validity of the additional instruments. Similarly, the  $R^2$  values of the first-stage regression changed little with the additional instruments; they were 0.23 for reading and 0.14 for math.

<sup>17</sup>I make no distinction between charters operating four years and those operating five or more years since there are fewer than 30 schools that began operation prior to 1998/99 and that were still in operation during the last year of the sample, 2001/2002.

higher differentials of 1.8 to 2.9 points. For reading scores there are no statistically significant differences between first-year charters and mature traditional public schools.

The results presented in Table 5 also show that math scores in charter schools generally improve as the school matures. The restricted value-added model estimates indicate that by their fourth year of operation math achievement gains are on par with those in traditional public schools. The value-added model results show a continuing, but diminished achievement gap in math of one scale-score point for fourth-year-and-older charters. In contrast to charter schools, traditional public schools do not demonstrate any consistent pattern of maturation effects.<sup>18</sup>

The results presented in Table 5 may not provide an accurate picture of charter school maturation effects because they do not control for the age of schools at the time they become charters. The vast majority of charter schools in Florida are created de novo. However, as indicated in Table 1, there are a growing number of "conversion charters" -- traditional public schools that choose to become charter schools.<sup>19</sup> Since these conversion charters have been in operation for many years one would expect that the number of years since becoming a charter school would not significantly affect their performance. Table 6 presents two sets of estimates which constrain the effect of age since acquiring charter status to be zero for conversion charters.<sup>20</sup> In the top panel non-conversion charter performance varies with age in a linear

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<sup>18</sup>The difference in maturation patterns between traditional public schools and charters is not surprising. Traditional public schools almost always start out with newly constructed facilities, an established curriculum, and can draw on administrators and faculty from established public schools. In contrast, charters often begin in temporary quarters designed for other purposes, must recruit faculty from a variety of sources and frequently are attempting to implement a new curriculum.

<sup>19</sup>In Florida, conversion requires separate affirmative majority votes by both the parents and faculty of a school and subsequent approval by the local school board.

<sup>20</sup>I also estimated models that allowed for a non-zero maturation effect for conversion charters that differed from that for non-conversion charters. The maturation effect for conversion charters was negative, but otherwise the results were nearly identical to the estimates presented in Table 6. Given the small number of older conversion charters, the negative estimated maturation effect could represent some unmeasured attributes of the particular schools that were early converters.

fashion while in the bottom panel separate intercepts are included for first-year, second-year and third-year non-conversion charters.<sup>21</sup>

When the distinction between conversion and non-conversion charters is made a clear maturation pattern for non-conversion charters emerges. Estimates from the value-added model indicate new non-conversion charters produce achievement test scores 2.0 to 2.4 points (12 to 14 percent of annual achievement gain) lower in math and 1.7 to 2.0 points (13 to 15 percent of annual achievement gain) lower in reading. These deficits diminish over time, however. In math the gap closes by about a half-point per year and there is no statistically significant difference between math achievement scores in fourth-year-and-older non-conversion charters and the average traditional public school. For reading, the improvement in achievement scores with charter age is even more rapid. Reading test scores are estimated to rise an average of 0.85 points with each year of charter operation and the difference between reading achievement scores in non-conversion charters and traditional public schools is insignificant beginning in the charters' second year of operation.

In addition to their age, charter schools vary in numerous dimensions, including curricular emphasis, the student population they serve and their organization. The models presented in Table 6 control for two important attributes of charter schools besides age: whether they target a particular student population and whether they are operated by a for-profit management company.

Greene, Forster and Winters (2003) argue that most comparisons of charter and traditional public schools are biased because a large proportion of charter schools are targeted to serve "educationally disadvantaged" populations such as students with disabilities, students at

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<sup>21</sup>Conversion charters are placed in the same category as non-conversion charters in their fourth or higher year of operation.

risk of dropping out and low-income and migrant students.<sup>22</sup> Given that I control for student characteristics with individual-specific fixed effects, this should not be an issue. However, if specialized charters place a greater weight on factors that are not measured by achievement tests (eg. life-management skills, vocational skills, foreign languages, performing arts, etc.) then they may have lower test scores than schools with a more traditional emphasis on core academic skills. To account for this, the models presented in Table 6 contain a dummy variable indicating charters that identify themselves as serving a targeted population.<sup>23</sup> In both the value-added and restricted-value-added models targeted charters are estimated to have test scores that are not statistically distinct from charter schools serving a general population.

The other dimension of charter schools I measure is their organization. In Florida, as elsewhere, the majority of charter schools are run by local non-profit entities. However, a growing number of charter schools are being managed by for-profit firms. If managers of for-profit educational firms are residual claimants on the net income of schools, they have a clear incentive to operate schools efficiently. Since operating revenues in charter schools are essentially constrained to equal the funding level of traditional public schools, for-profit management companies will have an incentive to minimize the cost of providing a given level of educational services. In contrast, operators of not-for-profit schools will seek to maximize their utility which typically would include the welfare of students, but might encompass other objectives as well.<sup>24</sup>

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<sup>22</sup>Greene, Forster and Winters find that when the school-level achievement gains of non-targeted charters are compared to those of traditional public schools, charters outperform the average traditional public school. However, their models do not account for the age of charters and exclude conversion charters. Since most non-conversion charters are young the relatively high year-to-year achievement gains may be due to charter maturation rather than a indicator of superior performance relative to traditional public schools.

<sup>23</sup>The information on targeting by Florida charter schools is based on survey data from Greene, Forster and Winters and a separate survey of Florida charters conducted by Robert Crew.

<sup>24</sup>For a more detailed discussion of the incentives in non-profit versus for-profit firms see Lien (2002) and references therein.

Thus from a theoretical standpoint it is not clear which type of firm would produce the greatest contribution to student achievement.

The estimates presented in Table 6 do not show any difference in the performance between nonprofit charter schools and charters run by for-profit management companies. In both the value-added and restricted-value-added models the differences in math and reading achievement test scores between the two types of organizational forms are statistically insignificant.

In order to measure the effectiveness of charter schools at different grade levels I re-estimate the value-added model for three grade groupings: elementary (grades 4-5), middle (grades 6-8) and high school (grades 9-10).<sup>25</sup> For reading, the negative effect of first-year charters is greatest in the earlier grades, but the maturation effect is greater as well. For elementary students, first-year charters are associated with a 4.2-point decline in achievement test scores, but this deficit is eliminated by the fourth year of operation. Similarly, for middle school students the first-year-charter deficit is 2.6 scale-score points and middle-school charters reach a par with traditional public schools in their fourth year of operation. There are no significant differences in reading scores between charter and traditional public high schools no matter what the age of the charter school. For math, the pattern is reversed; the differences between charters and traditional public schools are greatest at the high-school level. Students attending a brand-new charter high school experience a 5.5 point deficit in math achievement scores, but in the third year of operation the math achievement score deficit is eliminated. In contrast, there are no statistically significant differences in math achievement at the elementary school level no matter what the age of the charter school. Interestingly, these different patterns for reading and math

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<sup>25</sup>Given that achievement tests are administered in grades 3-10 and three annual scores are required to estimate the model, the elementary school group includes 5th grade students in 2001 plus thus 4th-grade students who repeated either grade 3 or grade 4.

achievement also show up in the measured effects of conversion charters. The effect of conversion charters is greatest (both in magnitude and statistical significance) at the high school level for math and at the elementary school level for reading.

The models presented in Tables 6 and 7 do not differentiate between charters targeting different populations of students. Approximately 18 percent of charter students in my sample attend a school that identified themselves as targeting a specific student population. Among students attending such "targeted" charters, over half attend a school that is designed to serve "at-risk" students. The second most frequent category of targeted charters are those with programs directed toward serving students with disabilities; 18 percent of students attending targeted charters go to schools that emphasize special education. The remaining 28 percent of students attending targeted charters are in a variety of programs. Some schools emphasize performing arts, multicultural education or primarily serve migrants or gifted students.

Estimates of a model that allows the impact of charter schools on student achievement to vary with the targeted population are presented in Table 8. I find no differences in student achievement between schools targeting "at-risk" students and other non-special-education student populations and those charter schools that do not target a particular group of students. However, I do find that schools targeting special-education students have dramatically lower achievement scores in both math and reading than non-targeted charters or traditional public schools, *holding student characteristics constant*. This result holds up whether the comparison group is all students in traditional public schools or only special-education students attending traditional public schools.

There are two likely explanations for the observed achievement differential between charters targeting special-education students and traditional public schools. First, it may be that

charters targeting special education place greater weight on skills that are important to special needs-students but that are not measured by standardized reading and math tests. For example, behavior control, social skills development and oral communication skills may receive greater weight in these schools. Second, there is the potential for negative peer effects in these schools. Not all students who attend special-education charters are disabled; some schools targeting special-education students have a mix of typical and special-needs children in their schools. If disproportionately greater resources are devoted to students with disabilities or special-education students themselves generate negative externalities, then the performance of typical peers in the same school may suffer.

*D. The competitive effects of charters on student achievement in traditional public schools*

To determine the competitive impact of charters on traditional public schools a geographic information systems (GIS) data base was constructed covering all public and private schools in Florida.<sup>26</sup> To account for the product dimension of the education market, enrollment data by grade were collected for all public and private schools in the state. This was used to group schools into three categories: elementary (grades K-5), middle (grades 6-8) and high school (grades 9-12). Schools could be included in more than one category if they served students in more than one grade-level grouping. Using the GIS and enrollment data the number and enrollment shares of charters, private schools and other traditional public schools serving the same grade levels (elementary, middle or high school) within 2.5, 5 and 10-mile radii of each traditional public school was determined.<sup>27</sup>

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<sup>26</sup>All charter schools, 98 percent of traditional public schools and 92 percent of private schools were geocoded based on their street address. The remaining schools were assigned latitude and longitude values based on the centroid of their 5-digit zip code.

<sup>27</sup>The 1.6 percent of traditional public schools with zip-code-level geocoding were excluded as center points from the competition analysis, but were included in the measures of competing traditional public schools.

If charter schools and/or private schools tend to locate where traditional public schools are performing poorly then measures of the number and size of charters and private schools would reflect not only the competitive impact of their existence but also (unmeasured) traditional public school quality. This would tend to bias downward the estimated effects of charter and private schools on student achievement in traditional public schools. To control for unmeasured time-invariant traditional school quality a school fixed effect,  $\theta_j$  (where  $j$  indexes schools), can be added to the achievement model. Denoting the vector of school competition measures by  $\mathbf{C}_{it}$ , the achievement model becomes:

$$(9) A_{it} = \beta_1 \mathbf{S}_{it} + \lambda A_{it-1} + \rho \mathbf{C}_{it} + \theta_j + v_i + \eta_{it}$$

Direct estimation of (9) is problematic since it requires inclusion of thousands of dummy variables, one for each traditional public school in the sample.<sup>28</sup> In order to make the problem computationally tractable I combine the student and school fixed effects into a single effect,  $\delta_{ij} = \theta_j + v_i$ , representing each unique student/school combination or "spell."<sup>29</sup> Employing the assumption that  $\lambda=1$  (the restricted value-added model) yields:

$$(10) \Delta A_{it} = \beta_1 \mathbf{S}_{it} + \rho \mathbf{C}_{it} + \delta_{ij} + \eta_{it}$$

Although individual and school effects are not separately identified, both individual and school heterogeneity can be eliminated by differencing the data with respect to spell means.<sup>30</sup>

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<sup>28</sup>The individual fixed effects can be removed by taking differences from individual means, but that still leaves the effects of the school dummies to be estimated explicitly.

<sup>29</sup>With very limited exceptions, charter schools in Florida must be approved by the local school district. Thus the spell fixed effects also capture any factors influencing the process of approving new charter schools.

<sup>30</sup>Use of the restricted value-added model is necessary to allow the use of mean-differencing to eliminate spell fixed effects. The Arellano and Bond dynamic panel data procedure used to estimate the unrestricted value-added model relies on first-differencing the data with respect to time. For a more detailed discussion of the spell fixed-effects approach see Andrews, Schank and Upward (2004).

Table 9 presents estimates of student achievement gains in traditional public schools as a function of various measures of competition. Each panel presents estimates of equation (10) using three geographic market definitions, but with different measures of competition added to each. In the first two panels competition is measured by the existence of charters, private schools and other traditional public schools. Panels 3 and 4 use the number of alternative schools as the yardstick of competition and panels 5 and 6 employ enrollment market share to gauge the extent of competition. For each of these measures, estimates of charter competition alone as well as competition from charters, private schools and other traditional public schools are provided.

The presence of one or more charters within a 2.5-mile radius is correlated with a 1.3 point increase in math achievement score gains. This is equivalent to an eight percent increase in the average yearly math-score gain in traditional public schools. Consistent with the expectation that more distant schools provide less competition, the estimated impact of the presence of one or more charter schools on traditional public school math achievement gains is found to diminish with the size of the geographic market definition. The presence of one or more charters within five miles is associated with a 1.2 point increase in math score gains while the presence of a charter school within 10 miles is correlated with a 0.9 increase in math score gains. The results are virtually the same when controls for the existence of nearby private schools and other traditional public schools are taken into account.

For reading, the effects of a nearby charter school on traditional public school performance are somewhat weaker. There is a marginally significant half-point increase in reading score gains (about four percent of the average 13.5 point gain) associated with the presence of one or more charters within 2.5 miles. Using a 5-mile market definition the presence of a charter is estimated to yield a 0.9 point higher average reading score gain. The effects of charter presence

on traditional public school reading gains are not significantly different from zero with the broader 10-mile market definition. As with math score gains, the estimated effects of the presence of charter schools on reading score gains in traditional public schools are robust to the inclusion of controls for the presence of private schools and other traditional public schools.

Each additional charter school located within 2.5 miles of a traditional public school is associated with a 0.8 higher scale score gain in math and a 0.5 higher scale score gain in reading or five percent of the average math score gain and four percent of the average reading score gain. These effects tend to diminish with the breadth of the geographic market definition. Using a 5-mile radius the annual achievement score gain associated with each additional charter school is 0.5 points in math and 0.2 points in reading. For the 10-mile market definition the estimated impact of an additional charter school on the average math gain remains at 0.5 but the effect on reading gains becomes statistically insignificant. Similar results are obtained when the numbers of competing private schools and traditional public schools are added to the model.

Model estimates using enrollment shares as the index of competition tell a similar story. For the 2.5-mile market definition each one percent increase in charter-school enrollment share is associated with a 0.14 increase in math score gains and a 0.09 point increase in reading score gains. Thus if charters were successful in gaining a relatively modest five-percent market share, the model would predict increases in traditional public school achievement score gains of 0.9 points in math and 0.5 points in reading. Using a 5-mile market definition the estimated impact of a one-percent increase in charter school market share on achievement gains is 0.11 in math and 0.18 in reading. For the broader 10-mile definition a one percent increase in charter-school market share is associated with a 0.31 increase in traditional-public-school math gains but is not found to have a statistically significant impact on reading gains. When controls for the market

shares of private schools and other traditional public schools are added to the model the estimated effects of charter market share become more precise, but there is little change in the estimated magnitudes.

Taken as a whole, the results provide relatively strong evidence of a net pro-competitive effect of charter school competition on traditional public school performance. While charter competition may produce negative peer effects by drawing away students from traditional public schools, this appears to be more than offset by the direct positive impact of charter competition on traditional public school performance. The net effect is relatively modest, but far from trivial, typically ranging in the neighborhood of four to 8 percent of the average annual achievement gain.

#### **IV. Summary and Conclusions**

As the charter school sector proliferates and more resources are devoted to building and expanding charter schools it is important to determine what those dollars are buying. This study begins to provide quantitative evidence on the effects of charter schools on both the achievement of students who attend charters as well as those who choose to remain in traditional public schools.

Consistent with other recent studies, I find that brand new charters tend to have lower student learning gains than the average traditional public school. However, of much greater importance is the long-run performance of charter schools. By their second year of operation Florida charter schools are found to reach a par with traditional public schools in reading. In mathematics, charter schools that are four year old and older have achievement test scores equivalent to the average traditional public school.

Charter schools are quite diverse; some are rather similar to traditional public schools while others seek to serve niches by targeting particular types of students (eg. special-education or at-risk students) or emphasizing particular programs (eg. music, art and languages). They also vary in their management structure, with most run as non-profit entities but a significant number operated by for-profit management companies. I find that charter schools which target special education students tend to have lower student achievement than non-targeted charters or the average traditional public school (holding student characteristics constant). The fact that parents willingly place their children in these schools (and keep them there) suggests that special-education charters may provide other valuable services beyond the core math and reading instruction tested on standardized exams, such as social-skills development or oral-communication skills. Management structure appears to have no impact on student achievement in charter schools; charters managed by for-profit firms perform the same as those operated by non-profit entities.

Competition from charter schools appears to have a net positive impact on student achievement in Florida's traditional public schools. Whether measured by the presence of nearby charter schools, the number of competing charters or the enrollment share garnered by charter schools, charter school competition is associated with higher math and reading scores in traditional public schools. The effects are not huge nor are they trivial; equivalent to roughly four to eight percent of annual learning gains.

My findings have several important implications for the evaluation of charter schools. First, it is clear that there are significant obstacles associated with establishing a new charter school and the performance of charter schools improves over time. Thus the age of charter schools must be taken into account when comparing their performance to traditional public

schools. In my sample charter schools reach a par with traditional public schools in both mathematics and reading achievement. Whether the upward trend in charter school performance will eventually lead to achievement scores that surpass those of traditional public schools is unknown at this juncture. Second, there is considerable diversity among charter schools. Charter schools that target specific student populations may have objectives other than simply maximizing scores on achievement tests in core subjects. Consequently, simply comparing the achievement of students in targeted charters with students in the average traditional public school may not always be appropriate. Third, it appears that competition from charter schools has a net positive impact on the performance of traditional public schools in Florida, though the size of the effect is modest. The charter sector is still rather small, however, and it is not clear how the magnitude of the competitive effects of charters will change as charter schools attract a larger proportion of the student population.

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**Table 1**  
**Charter Schools in Operation by Type, Changes in Operation**  
**and Charter School Student Membership in Florida, 1996/1997 - 2001/2002**

School Year	Charter Schools Operating			Changes in Operation		Membership		
	Total	Tar- geted	Con- version	Run by For-Profit	Openings	Closures	Number of Students	Pct. of all Public School Students
1996-1997	5	2	0	0	5	0	400	0.02%
1997-1998	31	10	1	0	26	2	3,500	0.15%
1998-1999	78	26	3	5	49	3	10,000	0.43%
1999-2000	113	40	3	8	38	2	17,200	0.72%
2000-2001	148	50	4	12	37	11	27,200	1.12%
2001-2002	190	58	7	28	53	0	39,900	1.60%

Note: the number of charters operating represents the number of charter schools in operation during any portion of the school year, including schools that closed during the school year. The count of charter schools is based on the assignment of school identification codes by the Florida Department of Education. Thus a single charter school may have two branches in distinct geographic locations or two charters serving distinct populations may physically reside in the same location. Charter Schools Opened includes all schools operating that did not exist at the end of the previous school year. Closures include all schools that ceased operating prior to the start of the next school year. Student totals are based on attendance during the October membership survey of public schools.

**Table 2**  
**Characteristics of Students by School Type -- Grades 3-10, 2001/2002 School Year**

	Traditional Public Schools	Charter Schools
Number of Students	1,643,842	26,293
Percent Black	24.29	27.91
Percent Hispanic	20.49	20.10
Percent Female	48.25	47.13
Percent Free/Reduced-Price Lunch	44.84	37.08
Percent with Limited English Proficiency	9.25	6.27
Percent in Special Education (Excluding Gifted)	15.29	13.94
Percent Gifted	5.58	4.18

**Table 3**  
**Enrollment Patterns of Students in Sample**  
**(Florida Students who Took the FCAT-NRT in**  
**Each of the Years 1999-2000, 2000-2001 and 2001-2002)**

Three-Year Enrollment Pattern	Number of Students	Percent
<i>All Students</i>	<b>873,468</b>	<b>100.00%</b>
<i>Students with No Observed Transitions</i>	<b>856,893</b>	<b>98.10%</b>
Traditional Traditional Traditional	847,162	96.99%
Unknown Traditional Traditional	3,172	0.36%
Traditional Traditional Unknown	3,259	0.37%
Charter Charter Charter	3,240	0.37%
Unknown Charter Charter	49	0.01%
Charter Charter Unknown	11	0.00%
<i>Students with One or More Observed Transitions</i>	<b>14,775</b>	<b>1.69%</b>
Traditional Charter Charter	3,424	0.39%
Traditional Traditional Charter	6,210	0.71%
Charter Traditional Traditional	1,994	0.23%
Charter Charter Traditional	1,494	0.17%
Traditional Charter Traditional	1,491	0.17%
Charter Traditional Charter	68	0.01%
Unknown Traditional Charter	40	0.00%
Unknown Charter Traditional	27	0.00%
Traditional Charter Unknown	10	0.00%
Charter Traditional Unknown	17	0.00%
<i>Students Without Two Contiguous Known Enrollments</i>	<b>1,800</b>	<b>0.21%</b>

**Table 4**  
**Estimates of the Average Effect of Charter Schools on Student Achievement**

	Math		Reading	
	Value-Added Model	Restricted Value-Added Model	Value-Added Model	Restricted Value-Added Model
Charter <sub>t</sub>	-1.544** (5.79)	-1.831** (4.06)	-0.126 (0.42)	0.201 (0.43)
Number of Schools <sub>t</sub>	-0.869** (8.73)	-0.691** (4.11)	-0.641** (5.60)	-0.790** (4.50)
Structural Move <sub>t</sub>	-0.839** (11.50)	-1.924** (15.72)	-1.068** (12.92)	-1.891** (15.01)
Non-structural Move <sub>t</sub>	-0.517** (7.66)	-0.867** (7.60)	-0.495** (6.47)	-0.717** (6.09)
Achievement Score <sub>t-1</sub>	0.062** (14.93)		0.233** (65.46)	
Number of Students	826,901	870,575	845,787	871,230

Note: absolute values of robust t-ratios in parentheses. \* indicates statistical significance at .05 level and \*\* indicates significance at the .01 level in a two-tailed test. All models include time/grade dummies and a constant as appropriate.

**Table 5**  
**Estimates of the Effect of Charter Schools on Student Achievement Controlling for School Age**

	Math		Reading	
	Value-Added Model	Restricted Value-Added Model	Value-Added Model	Restricted Value-Added Model
Charter	-1.929** (4.87)	-2.907** (4.31)	-0.786 (1.73)	-0.692 (0.98)
Charter × Age of Charter	0.222 (1.33)	0.621* (2.18)	0.373 (1.95)	0.504 (1.71)
First-Year Charters	-1.438** (3.25)	-1.843* (2.44)	-0.174 (0.34)	-0.155 (0.19)
Second-Year Charters	-2.144** (4.81)	-2.166** (2.89)	-0.690 (1.38)	0.244 (0.32)
Third-Year Charters	-2.152** (5.80)	-3.325** (5.28)	-0.419 (1.00)	-0.307 (0.48)
Fourth-Year and Older Charters	-0.996** (2.66)	-0.612 (0.97)	0.368 (0.86)	0.920 (1.41)
First-Year Traditional Public Schools	-0.243 (0.78)	-0.069 (0.13)	0.211 (0.59)	1.761** (3.23)
Second-Year Traditional Public Schools	-0.657** (4.09)	-0.072 (0.26)	0.063 (0.34)	0.611* (2.16)
Third-Year Traditional Public Schools	-0.190 (1.28)	-0.643* (2.54)	0.178 (1.05)	0.098 (0.38)
Number of Students	826,901	870,575	845,787	871,230

Note: absolute values of robust t-ratios in parentheses. \* indicates statistical significance at .05 level and \*\* indicates significance at the .01 level in a two-tailed test. All models include time/grade dummies and a constant as appropriate. Models also include control variables reported in Table 4.

**Table 6**  
**Estimates of the Effects of Charter Schools on**  
**Student Achievement Controlling for Charter School Age and Charter School Type**

	Math		Reading	
	Value-Added Model	Restricted Value-Added Model	Value-Added Model	Restricted Value-Added Model
Charter	-2.375** (3.95)	-4.103** (3.93)	-2.016** (2.93)	-2.018 (1.89)
Non-Conversion Charter × Age of Charter	0.520* (2.42)	1.241** (3.37)	0.847** (3.48)	1.147** (3.06)
Conversion Charter	3.829** (3.59)	4.254* (2.36)	2.911* (2.44)	2.645 (1.39)
Targeted Charter	-0.714 (0.94)	1.258 (0.98)	-1.204 (1.42)	-1.276 (0.99)
Charter Managed by For-Profit Firm	-0.524 (0.72)	-1.692 (1.41)	1.203 (1.53)	0.279 (0.23)
First-Year Non-Conversion Charters	-1.963** (2.71)	-3.323** (2.67)	-1.680* (2.05)	-2.363 (1.86)
Second-Year Non-Conversion Charters	-1.914** (3.25)	-1.431 (1.44)	-0.740 (1.11)	0.773 (0.75)
Third-Year Non-Conversion Charters	-1.915** (4.00)	-3.242** (4.01)	-0.233 (0.43)	0.228 (0.27)
Fourth-Year and Older Charters	-0.415 (0.87)	0.333 (0.41)	0.469 (0.85)	1.436 (1.72)
Conversion Charter	1.851 (1.85)	-0.161 (0.10)	0.434 (0.39)	0.681 (0.38)
Targeted Charter	-0.748 (0.98)	1.136 (0.89)	-1.127 (1.33)	-1.261 (0.98)
For-Profit Charter	-0.559 (0.77)	-1.786 (1.49)	1.014 (1.29)	0.152 (0.13)
Number of Students	824,134	869,779	842,851	870,470

Note: absolute values of robust t-ratios in parentheses. \* indicates statistical significance at .05 level and \*\* indicates significance at the .01 level in a two-tailed test. Models in lower panel include dummy variables representing traditional public schools in their first, second and third year of operation. All models include time/grade dummies and a constant as appropriate. All models also include control variables reported in Table 4.

**Table 7**  
**Value-Added Estimates of the Effects of Charter Schools on Student Achievement by Grade Level**

	Math			Reading		
	Elementary (Grades 4-5)	Middle (Grades 6-8)	High School (Grades 9-10)	Elementary (Grades 4-5)	Middle (Grades 6-8)	High School (Grades 9-10)
Charter <sub>t</sub>	-1.278 (0.78)	-2.001* (2.41)	-5.069** (4.44)	-4.176* (2.33)	-2.573** (2.67)	0.437 (0.32)
Non-Conversion Charter <sub>t</sub> × Age of Charter <sub>t</sub>	-0.707 (1.23)	0.370 (1.38)	2.400** (4.84)	1.379* (2.27)	0.763* (2.43)	0.948 (1.57)
Conversion Charter <sub>t</sub>	5.480 (1.86)	1.706 (1.17)	9.493** (4.72)	10.577** (3.59)	2.181 (1.35)	1.137 (0.46)
Targeted Charter <sub>t</sub>	-6.148* (2.45)	0.300 (0.29)	-3.150* (2.19)	-5.154* (2.05)	0.744 (0.63)	-2.751 (1.61)
For-Profit Charter <sub>t</sub>	-3.055 (1.38)	0.492 (0.52)	-0.030 (1.38)	2.620 (1.10)	1.408 (1.36)	-0.952 (0.59)
Number of Students	155,308	420,957	247,869	156,459	447,330	249,062

Note: absolute values of robust t-ratios in parentheses. \* indicates statistical significance at .05 level and \*\* indicates significance at the .01 level in a two-tailed test. Models include grade dummies and a constant as well as the control variables specified in Table 4. Since testing begins in grade 3, the grade-4 sample includes only those students who repeated grade 3 or grade 4 and thus have 3 annual test scores.

**Table 8**  
**Value-Added Estimates of the Effects of Charter Schools on Student Achievement**  
**Controlling for Charter School Age, Charter School Type and Target Population**

	All Students		Special-Education Students	
	Math	Reading	Math	Reading
Charter <sub>t</sub>	-2.821** (4.43)	-2.574** (3.56)	-3.121* (2.21)	-2.376 (1.31)
Non-Conversion Charter <sub>t</sub> × Age of Charter <sub>t</sub>	0.797** (3.52)	1.128** (4.39)	1.092* (2.11)	1.282* (1.97)
Conversion Charter	4.343** (3.94)	3.496** (2.86)	8.033** (3.01)	8.199** (2.65)
Charter Targeting "At-Risk" Students	-1.351 (1.34)	-1.949 (1.67)	1.760 (0.85)	-0.283 (0.10)
Charter Targeting Special-Ed. Students	-7.286** (3.82)	-6.244** (2.98)	-5.705* (2.45)	-7.593** (2.68)
Charter Targeting Other Students	2.243 (1.63)	2.692 (1.79)	-1.086 (0.28)	5.083 (1.16)
For-Profit Charter	-0.715 (0.96)	1.379 (1.68)	-3.208 (1.68)	3.020 (1.27)
Number of Students	824,005	842,707	166,623	170,869

Note: Absolute values of robust t-ratios appear in parentheses. All models include time/grade dummies and a constant as appropriate. Models also include control variables reported in Table 4.

**Table 9**  
**Restricted Value-Added Model Estimates of the Effects of**  
**School Competition on Student Achievement Gains in Traditional Public Schools**  
**(Student/School Fixed Effects)**

	Math			Reading		
	2.5-Mile Radius	5-Mile Radius	10-Mile Radius	2.5-Mile Radius	5-Mile Radius	10-Mile Radius
One of More Charters	1.321** (4.62)	1.203** (4.38)	0.890** (3.74)	0.541 (1.81)	0.866** (3.04)	-0.299 (1.21)
One of More Charters	1.318** (4.61)	1.192** (4.34)	0.856** (3.58)	0.541 (1.81)	0.846** (2.97)	-0.292 (1.18)
One of More Private Schools	0.045 (0.12)	0.443 (0.68)	0.846 (0.92)	0.136 (0.34)	0.968 (1.44)	-0.589 (0.60)
One of More Other Trad. Public Schools	0.588 (1.37)	0.392 (0.56)	-1.731 (1.77)	-0.025 (0.06)	0.403 (0.55)	0.377 (0.37)
Number of Charters	0.793** (3.79)	0.454** (4.02)	0.491** (6.88)	0.498* (2.28)	0.232* (1.96)	-0.011 (0.15)
Number of Charters	0.778** (3.71)	0.461** (4.08)	0.503** (7.03)	0.527* (2.41)	0.231 (1.95)	-0.024 (0.32)
Number of Private Schools	0.072 (0.83)	0.174** (3.52)	0.084** (2.80)	-0.189* (2.09)	-0.045 (0.87)	-0.085 (2.70)
Number of Other Trad. Public Schools	0.202 (1.52)	0.067 (1.06)	0.032 (0.90)	0.190 (1.38)	-0.004 (0.06)	-0.071 (1.90)
Market Share of Charters	0.135** (3.58)	0.112 (1.73)	0.312** (4.30)	0.090* (2.28)	0.175* (2.53)	0.026 (0.34)
Market Share of Charters	0.139** (3.64)	0.134* (2.01)	0.317** (4.01)	0.099* (2.47)	0.192** (2.69)	0.115 (1.37)
Market Share of Private Schools	-0.082 (1.86)	0.070 (1.17)	0.071 (0.86)	-0.094* (2.07)	-0.040 (0.66)	0.035 (0.40)
Market Share of Other Trad. Public Schools	0.035* (2.56)	0.014 (0.85)	0.001 (0.06)	0.054** (3.73)	0.043* (2.39)	0.068** (2.74)
Number of Students =	859,068	859,068	859,068	859,846	859,846	859,846

Note: All models include time/grade dummies and a constant as appropriate. Models also include control variables reported in Table 4 and fixed effects for each unique student/school combination.