An Examination of Student Achievement in Michigan Charter Schools

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Abstract

Since their inception in 1991, the number of and the student enrollment in charter schools have burgeoned. However, little attention has been paid to their effects on student achievement. Proponents hypothesize *direct* and *indirect* positive impacts of charter schools on student achievement. The direct effect is through the restructuring of teaching and learning processes. The indirect effect operates through peer effects on learning and through the market forces of competition.

This paper focuses on student achievement in charter schools in Michigan. The analyses presented here suggest that students attending charter schools in Michigan are not reaching the same levels of achievement as students in traditional public schools in the same districts. Using several different models to estimate the difference between test score levels of students attending charter schools versus those from traditional public schools in the same districts, we find that students attending a charter school scored around 2 to 4 percent lower on the state's mandatory fourth grade reading and math assessments; the fifth grade students in charter schools scored about 4 percent lower on the science test and about 6 to 9 percent lower on the writing test. The models control for student, building, and district characteristics.

The results are robust to several different specifications. However, many caveats are in order. Test scores are imperfect indicators of achievement. Furthermore, while we examine test scores of individual students, we are able to control for student and teacher characteristics in only a limited way and some of our explanatory variables are based on aggregate building-level and district-level information. Nevertheless, our analyses suggest that despite the fact that charter schools have the ability to introduce competition and new innovations in the provision of education, the evidence from this study implies that they will need to make up considerable ground as they become more established in order to overtake the test score levels and gains of students at traditional public schools.

An Examination of Student Achievement in Michigan Charter Schools

Proponents of school reform have argued that charter schools and vouchers can provide adequate market pressure to improve the performance of traditional public schools. It is certainly the case that charter schools have blossomed in number since their inception. Minnesota passed the first charter school law in 1991, and since then more than 30 states have put such laws in place. Approximately 2,000 charter schools are in operation nationwide, enrolling over 500,000 students. Arizona, California, and Michigan have led the movement, accounting for about 40 percent of those schools and over half of the students.[1] While the number of charter schools and student enrollment have burgeoned, relatively little attention has been paid to their effects on student achievement.

Are there theoretical reasons to expect that charter schools might have an effect on student achievement? We suggest that proponents of charter schools see a *direct* and an *indirect* chain of logic to argue that charter schools will have a positive influence on student achievement. The direct effect is through the restructuring of teaching and learning processes. Individuals or groups establish a charter school because they have an instructional or curriculum innovation they wish to implement, or because they want regulatory relief from obstacles that they feel are impeding the learning process. Charter schools give them the opportunity to implement these innovations or remove the obstacles, and thus to directly enhance student learning. The indirect effect operates through peer effects on learning and through the market forces of competition. If student achievement is influenced by the composition of peers in the classroom, and if charter schools attract students who are more serious or have other characteristics that are complementary to learning, then student performance in charters will exceed achievement in traditional public schools. In addition, the necessity of competing for

[1]Hassel (1999) describes the process by which Michigan legislators passed the charter school bill. He notes that Michigan produced strong charter school laws within a strong union environment. However, his analysis of the 30 states that passed charter school laws shows no statistically significant difference between the passage of such laws and the extent and strength of collective bargaining in the state.

students may cause charter schools to emphasize student achievement under the assumption that parents and students value higher achievement when choosing schools. Of course, it may be the case that competitive pressures result in higher achievement in traditional public schools as well, which would reduce or alleviate any achievement advantage that charter schools might have.

This paper focuses on student achievement in charter schools in Michigan. Michigan's law was passed in 1993, and currently183 charter schools now enroll approximately 58,000 students, or about 3.4 percent of Michigan's K-12 student enrollments (Horn and Miron 1999). The analyses presented here suggest that students attending charter schools in Michigan are not reaching the same levels of achievement as students in traditional public schools in the same districts.[2] On the one hand, this result is not surprising because the charter schools are a new entity and they may be traversing a learning curve. On the other hand, the result is very surprising because there is strong evidence of positive selection into charter schools. Enrollment requires active parental intervention, and some studies allege that charter schools' application and selection processes may allow student screening, although that is not allowed by law.

The next section of the paper presents background information about charter schools in Michigan. The following section describes our data. Then we present the econometric analyses of the data, and finally draw conclusions.

[2]We use the term "traditional public schools" to denote buildings administered by local districts and not chartered.

CHARTER SCHOOLS IN MICHIGAN

According to Michigan law, the primary purposes of charter schools, referred to as public school academies (PSAs), are as follows:

- Improve pupil achievement;
- Stimulate innovative teaching methods;
- Create new professional opportunities for teachers;
- Achieve school-level accountability for educational performance;
- Provide parents and pupils with greater choices among public schools;
- Create competition among public schools to use state funds more effectively, efficiently, and equitably (Horn and Miron 1999, p. 18).

This set of purposes reflects the intent of the original proponents of charter schools (Hassel 1999). The state legislation that authorized charter schools established a set of operating rules and practices. Each school is authorized for a particular mission with identified and explicitly stated goals and purposes unique to that mission. Teachers must be certified just as they are at other public schools. Schools may not screen students, but they may limit the number of students they serve. If more students apply than can be enrolled, a random selection process is used. Charter schools are free to choose their own core curriculum and are not required to provide services to meet the needs of all students, such as those with special needs. Charter schools are subject to all laws and regulations that apply to public schools, and charter schools receive the same state foundation grant on a per-pupil basis as do traditional public schools. Charter schools cannot charge tuition, but they can raise funds through legal foundations and receive grants (Horn and Miron 1999, p. 3).

State law requires that public educational institutions authorize charter schools. Of the 183 charter schools, 149 have been authorized by universities (or community colleges) and 34 by local public school districts (including intermediate school districts). Charter schools are governed by a board, which is approved by the authorizing entity. Board members are public officials and are subject to all applicable laws. However, unlike regular school board members, they are not elected by parents or any other specified group and instead are officially appointed by the authorizing institution.

An evaluation of Michigan charter schools (Horn and Miron 1999) offers insights into their structure and how closely they are able to adhere to the principles upon which the charter school law was established. To state succinctly, charter schools are intended to identify a specific set of goals, align their resources to pursue those goals, offer ways to evaluate the performance in meeting the goals, and thus hold teachers and administrators more accountable for educational achievement.

The evaluation cited several shortcomings with respect to the current practice of charter schools, however, and recommended the need for improvement in the following areas:

- Vague mission statement and justification of the need for the charter school;
- Real or potential conflicts of interest among employees and board members;
- Lack of congruence between curriculum and the philosophy/mission of the school;
- Inappropriate or nonexistent assessment and evaluation procedures for students and employees;
- Limited innovations being developed and applied in the charter schools (Horn and Miron 1999 p. 101).

Of course, some charter schools did better than others in achieving their objectives.

DATA

In order to analyze the effectiveness of charter schools relative to their traditional public school counterparts, we examine the difference in student outcomes, as measured by the Michigan Educational Assessment Program (MEAP).[3] The MEAP tests are convenient measures of the educational outcomes of Michigan students since all public school students, including charter school students, are required to take the tests. The tests are administered to students in specific grade levels. Most relevant for comparing student performance in charter schools versus traditional public schools are the tests administered in the fourth and fifth grades, since most charter schools in the state enroll students in grades K-6. The state makes available the MEAP results each year along with limited demographic data that are self-reported by students when they take the tests. We rely mainly on this data set together with additional building- and district-level data that are supplied by local districts and made available on the Michigan Department of Education's website. Three years of MEAP scores for individual fourth- and fifth-grade students are available from 1996/97 through 1998/99.

The MEAP tests are criterion-referenced exams, so the "cut scores" may differ from year to year. However, our analyses are based on levels, not passing rates, and the standards to which the MEAP is aligned did not vary over the three years of our data. Consequently, pooling the data over time is not a problem. The MEAP program consists of reading and mathematics tests in grade 4 and writing and science tests in grade 5. This makes it impossible to examine educational gains in specific subjects. Nonetheless, in one model specification, we control for pre-test achievement by using the student's MEAP score from the test taken the previous year. We use the fourth grade mathematics test as proxy for a pre-test for the fifth grade science test, and we use the fourth grade reading test

[3]The evaluation conducted by Horn and Miron did not examine differences in student test scores between PSAs and regular public schools using regression analysis and controlling for additional factors.

as a pre-test for the fifth grade writing. The results using gains are qualitatively the same as the results using levels. However, for the most part, we rely on analyses of test score levels. It is well-known that test score levels are highly correlated with student characteristics, particularly family income. Thus, comparisons across districts or schools may be biased against schools with high percentages of disadvantaged students. In order to attenuate this compositional problem, we have limited our sample to charter school students and districts that "house" the charters.[4]

Adequate controls for the composition of students and other factors outside of the school's control are difficult to obtain. The MEAP program is designed to allow district staff to denote whether the test taker is eligible for free or reduced price lunch. However reporting is very sporadic, making that variable useless on an individual level. The Michigan Department of Education (MDE) reports the percentage of students eligible for free lunch on a building level, but many charter schools do not report these data to the state.[5] We do use the building-level eligibility percentages as supplied by MDE in our empirical analyses, but these types of data problems make it very difficult to control for student characteristics.

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[4]From the available data, it is impossible to know exactly the set of "host" districts, i.e., the set of districts that students in the charter schools would have attended in the absence of the charter schools. We used the document, *Directory of Michigan Public School Academies*, supplied by the Michigan Department of Education (2000), for data on when the charter school opened, grades served, and usage of an educational management company. This document also provides an Intermediate School District (ISD) and local school district for the charter school. The local school districts listed comprise our "host" districts with the following exceptions: Concord Academy of Antrim was matched with Mancelona rather than Alba because of missing data; Questar Academy was matched with Carman-Ainsworth, Flint, and Beecher; Traverse Bay Community School was matched with Traverse City rather than Elk Rapids because of missing data; daVinci Institute and Paragon Charter Academy were matched with Jackson and Vandercook Lake; the three charter schools in Kalamazoo County were matched with Kalamazoo and Portage; TriValley Academy was matched with Muskegon and Orchard View; and Francis Reh PSA was matched with Saginaw City and Saginaw Township schools.

[5]Of the 89 charter schools included in the sample (1998/99 data), 44 report that no student in their school receives free and reduced price lunches. It is unclear whether this reflects the student's eligibility or poor reporting. Horn and Miron (1999) report that several principals indicated that they did not enroll eligible students in the free lunch program because their school did not offer a hot lunch, and they did not see the point to pursue their eligibility.

We also acknowledge that the MEAP test scores, like any standardized test scores, are "loose" indicators of student achievement. The environmental conditions under which students take the test, test coverage, and student test-taking skills and anxiety all influence the extent to which the scores accurately reflect what students actually know. Furthermore, to the extent that a student's performance on the MEAP is related to the totality of their educational experiences prior to the exam, it is incorrect to fully attribute the test score to the current school of attendance if students have transferred into that school. Most of the charter schools have recently opened, and so the proportion of students who have transferred in is much higher than for traditional public schools. Finally, the MEAP test may not be aligned with the curriculum established by the charter school. Traditional public school administrators and teachers have also echoed this criticism of the MEAP, which underscores the problems of using standardized test measures as evaluation instruments.

Nonetheless, the MEAP test is one of the few ways to compare the performance of all public schools. With greater attention given to accountability of schools, the state of Michigan, along with many other states, has stressed the importance of the MEAP scores.[6] Many Michigan school districts are spending considerable time and resources to improve their performance on the MEAP. Furthermore, according to the evaluation, many charter schools use the MEAP as evidence of the success of their program and some charter schools list the MEAP test as their only evidence of student achievement (Horn and Miron 1999, p. 83).[7]

[6]Some states, notably South Carolina and Kentucky, use statewide tests, along with other factors, to allocate state resources to schools. Michigan does not, but the state does award postsecondary scholarships to students based on their middle school and high school MEAP tests.

[7]Researchers and evaluators use other measures of student outcomes, such as drop out rates (e.g., Hoxby 1996). However, since most charter schools include only K-8 grades, drop out rates are not meaningful, and are not recorded.

We examine the MEAP test scores for all fourth and fifth grade students in charter schools and in the public schools of districts within which the charter schools are located. By pairing charter schools with their "host" (meaning geographically co-located) districts, we attempt to create the local "market" for educational services in which both the charter schools and the public school districts compete. Table 1 provides descriptive statistics from the data set that we have constructed. Except for a few observations that have been deleted because of missing values for key variables, the number of students included in the table is exactly equal to those who took the MEAP test in the districts included in the analyses. The test is mandatory in Michigan, with only a few waivers, so the number of test takers is a good proxy for the relative number of students in traditional public and charter elementary schools. Whereas on a statewide basis charter schools enroll about 3.4 percent of all students, the table shows that charters account for about 7.1 percent of the fourth-grade test takers in the districts in our data set for the 1998/99 school year.

Note that in general, charter schools have smaller enrollments than public schools. In fourth grade for the latest year of data, the average building enrollment for charters was 276, which is about 60 percent of the average building enrollment in the traditional public schools. Class sizes are also apparently smaller. The average student/teacher ratios for charter schools are between 18.5 to 19.0, whereas they are between 22.5 to 24.0 for traditional schools. The ethnicity and poverty status of students in the two types of buildings are somewhat different also. The building data from the MDE show nonwhite enrollment percentages of around two-thirds (66 percent) to three-fourths (75 percent), whereas the charter school percentages are about 10 percentage points lower. The percentage of students in a building in poverty as measured by eligibility for free or reduced price lunch is around 55 to 60 percent for traditional public schools and around 45 to 50 percent for charter

schools. There has been some concern about trends in the characteristics of charter school students toward majority ethnicity and non-poor economic status.[8] But our data do not confirm any such trend, and in fact, the free lunch eligibility percentage remains constant over the three years of data, and the nonwhite enrollment percentage increases.

Average teacher salaries are much lower in charter schools. In fact, they are approximately two-thirds as large as the average salaries in traditional public schools in all three years of the data. Similarly, average expenditures per pupil are lower in charter schools. However, the gap between charters and traditional public schools in average expenditures per pupil gets smaller over the three years of data. For buildings with fourth- grade students, the average expenditure per pupil in charter schools is about 83 percent of the average expenditure per pupil in districts that "host" charter schools in 1996/97 and about 92 percent in 1998/99. These data, along with the much larger gaps in teacher salaries, confirm the fact that charter schools spend a much larger share of their per pupil expenditures on noninstructional items (see Good and Braden 2000).

The average test score data in the table presage the multivariate analyses of achievement results presented below. The average scores for students in charter schools are approximately two to three percent lower than the scores for students in traditional public schools. (These gaps translate to differences that are approximately 0.3 to 0.4 standard deviations and are highly statistically significant.) For example, in the last year of data, the average math score is around 531 for fourth graders in traditional public schools and about 517 for fourth graders in charter schools. The averages for fifth graders for science are about 380 and 369, respectively.

[8]In their evaluation, Horn and Miron (1999) report that although many charter schools formed during the first few years targeted minority students, the trend in more recent years has been the opposite. The percentage of white students has risen from 35 percent in 1995 to about 60 percent in 1999.

ANALYSES

We have used several models to estimate the difference between test score levels of students attending charter schools versus those from traditional public schools. Since we paired the charter school with public school districts, we use fixed effects to control for factors in the areas that are common to both types of schools. This approach helps to control for the average difference in students across districts, but it does not control for differences between charter schools and public schools within each district.

We consider the MEAP test scores of fourth and fifth graders for three school years, 1996/97 through 1998/1999. The log of test scores are regressed on three groups of variables. The first set of variables is intended to control for individual differences across students. It includes demographic characteristics that are (self-)reported by the students—sex and race/ethnicity—and the percentage of students in each school eligible for free or reduced price lunches. As noted above, individual eligibility is not available for each student, so we entered it as a building-level variable.

The second set of variables relates to school environment. We include the building-level pupil/teacher ratio and enrollment in logs. The third set of variables is intended to measure the amount of resources available: average teacher salary and expenditure per pupil. Average teacher salary is intended to proxy for teacher quality. Since PSAs and public schools are aligned within the same local area, the cost of living is the same for schools within each local area. As a result, the difference in teacher salaries reflects the experience and educational qualifications of the teachers. Salaries may also differ because of compensating differentials with respect to work environments. Teachers who prefer the charter school environment may be more willing to work there for lower

pay.[9] Expenditures per pupil proxy the amount of school-based resources available at the building level.

In the estimates discussed below, the coefficients on these three sets of variables generally have the expected signs and are statistically significant, with and without fixed effects included. Whereas the primary focus of the paper is the difference in the level of student test scores between PSAs and traditional public schools, it is noteworthy that the coefficients on the control factors are significant and have the expected signs, and they are robust to alternative specifications. Table 2 provides the estimates from our preferred model specification, with fixed effects, using the latest year of data for reading (fourth-grade test) and for science (fifth-grade test).

The table shows that among the personal characteristics that are available on the data set, female students outperform males by just under 2 percent on the reading test and achieve virtually the same scores on average on the science test (the difference is positive, but it is not statistically significant.) Nonwhites score about 2 percent lower on the reading test and about 4 percent lower on the science test than white students.

The building characteristics are generally all significant and of the expected sign. The free lunch eligibility percentage, building enrollment, and pupil/teacher ratio in the building are all negatively associated with reading and science scores. Building enrollment and pupil/teacher ratio are entered into the model in log form, so the coefficients are elasticities. For both of these variables, a 5 percent increase (which is approximately 20 students in building enrollment for traditional public schools and 15 students for charter school enrollment, and an increase of 1.0 in pupil/teacher ratio

[9]Unfortunately, average teacher salary was missing for many charter schools and was ultimately dropped from the analyses. We have estimated many of the models on the subset of data in which there is average teacher salary data, and the results are largely unchanged.

for both) is predicted to reduce test scores for both tests by about 2.5 to 3.0 percent. The free lunch eligibility variable is measured in percentages, so the mean school, which is about 50 percent in both traditional public schools and charter schools, has student scores that are about 3 to 5 percent lower than a school with no students eligible.

Resources seem to improve student achievement. Expenditures per pupil in the district (for traditional public schools) or at the building level (for charter schools) are positively related to test scores, although the elasticity is not statistically significant for science. The estimates suggest a fairly sizeable effect. A 5 percent increase in expenditures per pupil, which translates to about $350, is predicted to increase reading test scores by over 10 percent.

In the models presented in Table 2 and in virtually all specifications, students attending PSAs have lower test scores than students in traditional public schools even after controlling for student, building, and district characteristics. The magnitude of the results vary by grade, year, and subject matter. The differentials are generally larger for those subjects that arguably are more dependent upon school-based instruction than home-based instruction. For example, the PSA differentials for fourth-grade math and fifth-grade science and writing test scores are larger than the differentials for reading under most specifications. One could argue that parental help with reading could mitigate the effects of inferior school-based instruction. Unfortunately, we do not have any measures of home-based activities to control for this effect.

Table 3 provides impact estimates from our basic specification for each of the four tests from each year plus for the data pooled together. The dependent variables for these models were the logarithms of test score levels, so the coefficients presented in the table may be interpreted as percentages. Note that students attending a charter school scored around 2 to 4 percent lower on

reading and math tests; the fifth-grade students in PSAs scored about 4 percent lower on the science test and about 6 to 9 percent lower on the writing test. All of these results are strongly statistically significant.

The negative coefficients on the PSA dummy variable may be interpreted as the direct impacts of charter schools, but they do not necessarily address the indirect impacts. That is, the competition or "threat" posed by charter schools may increase the test scores in traditional public schools, which of course would be a positive impact on education. To test for such an indirect effect, we estimated the same models on all traditional public school buildings in all districts in Michigan, and included a dummy variable for presence of a PSA in the district. The results of this exercise are presented in Table 4. The upper panel of the table reports the coefficients on the variable indicating presence of a PSA for all four tests for the sample with all years of data combined. This part of the table reports estimates using a specification with district fixed effects. Fifth-grade students in districts that "host" a charter school do score about one and one-half percent higher on the writing test than students from other districts, controlling for student, building, and district characteristics, but fourth-grade students do not score higher on the math or reading tests.

Some PSAs enroll only students in grades K-4, so we might hypothesize that the indirect, "threat" effect will occur only in fourth grade. The fourth-grade results in the upper panel of the table, however, are at odds with that hypothesis; if anything, the effect occurs in fifth grade. However, note two things. First, the magnitude of the effect is a small fraction of the size of the impact estimate presented in Table 3. Second, the bottom panel of the table provides indicators of the trend in the "threat" effect. That portion of the table presents the coefficients on the dummy variable for presence of a PSA for each year of the data in a specification without district fixed effects

(but with the other independent variables).[10] If the "threat" effect were responsible for these coefficients, then we would expect them to grow over time as more and more charter schools open. However, the coefficients decrease over time. Taking these two facts into consideration, we conclude that there is little evidence for the indirect effect of charter schools on test performance.

Charter schools are relatively new, so one possible explanation for the lower test scores of their students may be the inexperience of PSA staff and the inefficiencies of starting up a new venture. One could also argue that students have not been enrolled long enough in charter schools to make a difference in their performance.[11] However, Table 3 does not seem to show a downward trend in the negative impacts (except for writing) with more and more recent data. We explicitly tested for a trend by adding to the model an interaction between PSA status and years since the PSA opened.[12] Table 5 shows the results of this test for the pooled samples, and indeed, the PSAs do seem to improve their performance, by about 0.9 percent per year for each of the tests. If this trend continued in a linear trajectory, it would then take about 6 to 10 years for students in PSAs to catch up to students in traditional public schools.

Some proponents of charter schools argue that school performance would improve if schools would follow business practices more closely. The majority of charter schools in Michigan are, in fact, managed by for-profit businesses. Table 6 shows the results of replacing the PSA dummy variable from our basic specification with two variables, one indicating whether or not the PSA is managed by a for-profit company and the other indicating whether or not the PSA is managed by

[10]Because of data limitations, the fixed effect models were not estimable for the individual years of data.

[11]However, we must keep in mind that students in PSAs possess, on average, higher levels of personal characteristics that are positively associated with test scores.

[12]We also tested an interaction with a quadratic in the trend term, but it did not add any explanatory power.

some other entity. The two variables are mutually exclusive and together represent the entire group of PSAs that were in the previous analysis. The results show that PSAs managed by for-profit companies have lower test scores relative to public schools than do PSAs not managed by for-profits. The results are not consistent with the position that market alternatives yield better student performance, as measured by test score levels, assuming that schools run by educational management organizations (EMOs) are not systematically different from other charter schools with respect to the other variables in the model. Note that in Michigan, about 70 percent or more of the charter schools are managed by an EMO.

The next set of specifications attempts to disaggregate the negative impacts of charter school attendance on test scores to determine if there was a systematic difference by the observed student characteristics. In particular, we examined the impact on nonwhite students and by the percentage of students in the building eligible for free or reduced price lunch. Table 7 shows the results of adding interaction terms between the PSA dummy variable and student being nonwhite and building eligibility for free or reduced price lunch (as well as the three-way interaction between the three variables.).[13] The coefficient on the interaction terms are generally insignificant. These estimates demonstrate that the negative charter school effect is similar for disadvantaged students or minority students as it is for advantaged students or whites. In other words, the results do not point to any special improvement for disadvantaged or minority students.

The use of test score levels to compare the performance of schools is problematic, particularly when only a limited number of variables are available to control for student characteristics and home-

[13]We estimated the same model using the building percentage nonwhite rather than the individual characteristic and found very similar results. The coefficient on the interaction between PSA dummy and building nonwhite percentage was significantly negative.

and school-based resources. As mentioned earlier, test score gains for individual students cannot be computed, because the MEAP tests cover different subjects each consecutive school year and because it is not possible to track individual students across years with the publicly available data. An alternative, albeit inferior, approach may be pursued. A substantial share of the fourth graders who took tests in the first two years of our sample also took fifth-grade tests the next year. We matched these students' records and then estimated a model in which the students' fourth-grade math score is used as a control variable for fifth-grade science, and the students' fourth-grade reading score is used as a control variable for fifth-grade writing.[14, 15] Table 8 presents the results from these estimations with fourth grade scores from 1997/98 used as pretests for 1998/99.

The negative impacts for science and writing were attenuated slightly from what is reported in Table 3. The science disadvantage decreased from about 3.3 percent to 2.2 percent, and the writing disadvantage declined from 7.0 percent to about 4.2 percent. When the model was run with nonwhite and reduced price lunch eligibility interactions, the results again show that the negative gap does not change for nonwhite or disadvantaged students.

SUMMARY AND CONCLUSIONS

The analysis of individual student test scores suggests that charter schools, during their years of operation in Michigan, have not improved student achievement relative to traditional public

[14]The procedures that we followed for matching students from fourth to fifth grade were as follows: (1) all observations with missing values for ethnicity, gender, and date of birth were deleted; (2) remaining observations were matched by district, building, ethnicity, gender, and date of birth; and (3) all observations with multiple matches were deleted. This procedure yielded a match rate of about 24 percent. Many of the nonmatches were presumably due to students moving to different schools.

[15]The (zero-order) correlations between the fourth-grade reading test score and the fifth-grade writing test score and between the fourth-grade math test score and the fifth-grade science test score were on the order of 0.76.

schools. If charter schools enrolled students who are academically challenged, then sample selection would be biased against levels and gains in test scores for students in charter schools. However, charter schools enroll a lower percentage of students eligible for free or reduced price lunch program and a lower percentage of minorities, which are characteristics that tend to be correlated with lower achievement. Furthermore, the active choice by parents to send their children to charter schools would suggest that these students have home support for education, which would suggest a bias in favor of higher levels and gains in test scores. Consequently, one could argue that our estimates of the differential between test scores of traditional public schools and charters may be smaller than they actually are, since we have not controlled for this selection bias.

It is interesting to note that charter schools run by for-profit businesses, which arguably are driven more by market incentives than are not-for-profits, have lower test score levels than the other charter schools, which are typically not-for-profit operations. It may take management companies longer to establish effective operations because of the scope of their operations and location of decision makers. It may be the case that not-for-profit charter schools focus more specifically on teaching and learning practices. Parental involvement and empowerment may differ at the two types of charter schools. At any rate, these results seem counterintuitive to the point of view that business decisionmaking should improve test scores and is thus an area that warrants further (qualitative) investigation.

The results presented here on the effect of charter school attendance on student achievement are not conclusive. Test scores are imperfect indicators of achievement. While we examine test scores of individual students, we are able to control for student and teacher characteristics in only a limited way and some of our explanatory variables are based on aggregate building-level and district-

level information. Were it possible to design a controlled experiment or find an appropriate natural experiment so that we could rigorously control for selection bias, we could have more confidence in the estimated gaps. Nevertheless, our analyses suggest that despite the fact that charter schools have the ability to introduce competition and new innovations in the provision of education, the evidence so far suggests that they will need to make up considerable ground as they become more established in order to overtake the test score levels and gains of students at traditional public schools.

Table 1 Descriptive Statistics for Selected Student and School Characteristics
(standard deviations in parentheses)

Characteristic	Charter Schools		Traditional Public Schools	
	4th Grade	5th Grade	4th Grade	5th Grade
		1996/1997		
Number of schools/districts	29	35	366/24	434/27
Number of students	751	622	22,121	24,163
Female	48.9% (50.0)	47.4% (50.0)	50.5% (50.0)	50.8% (50.0)
Nonwhite	59.8% (49.1)	54.5% (49.8)	76.0% (42.7)	69.0% (46.2)
Free lunch eligibility, bldg.[a]	49.3% (26.7)	49.3% (26.7)	59.2% (25.4)	58.9% (25.7)
Nonwhite enrollment, bldg.[a]	52.0% (39.5)	54.2% (37.8)	70.8% (33.8)	67.8% (35.3)
Average enrollment, bldg.	199 (130)	196 (124)	475 (218)	470 (204)
Ave. pupil/teacher ratio, bldg.	18.6 (3.8)	18.8 (4.5)	23.6 (3.9)	23.9 (4.3)
Average teacher salary, dist.[a]	$31,034 (7899)	$30,117 (7802)	$46,638 (7122)	$46,979 (6906)
Ave. expenditure/pupil, dist.	$5,685 (1507)	$5,538 (1418)	$6,862 (1137)	$6,920 (1089)
Mean math (science) score	507.0 (30.1)	371.9 (32.4)	521.2 (34.1)	383.0 (33.9)
Mean reading (writing)[b] score	304.1 (28.3)	2.45 (0.62)	311.0 (26.5)	2.52 (0.56)
		1997/98		
Number of schools/districts	61	57	522/44	495/41
Number of students	1,661	1,331	29,750	28,444
Female	50.3% (50.0)	53.0% (50.0)	51.1% (50.0)	50.6% (50.0)
Nonwhite	59.7% (49.1)	57.4% (49.5)	66.9% (47.1)	64.0% (48.0)
Free lunch eligibility, bldg.[a]	47.7% (32.4)	46.0% (32.2)	56.4% (26.6)	57.8% (25.5)
Nonwhite enrollment, bldg.[a]	58.1% (38.4)	54.9% (39.1)	65.8% (35.1)	65.1% (35.9)
Average enrollment, bldg.	243 (175)	249 (177)	448 (199)	449 (200)
Ave. pupil/teacher ratio, bldg.	18.5 (4.6)	18.3 (4.5)	23.4 (3.8)	23.4 (3.8)
Ave. teacher salary, dist.	$31,973 (7655)	$31,511 (7186)	$46,916 (6645)	$47,058 (6735)

Table 1 (Continued)

Characteristic	Charter Schools		Traditional Public Schools	
	4th Grade	5th Grade	4th Grade	5th Grade
Ave. expenditure/pupil, dist.	$5,957 (1177)	$6,008 (1203)	$7,253 (1301)	$7,185 (1247)
Mean math (science) score	522.5 (28.5)	375.6 (29.8)	533.5 (31.4)	385.1 (32.9)
Mean reading (writing)[b] score	309.6 (24.9)	2.41 (0.60)	315.3 (25.7)	2.43 (0.56)
		1998/99		
Number of schools/districts	89	85	619/56	592/54
Number of students	2,776	2,164	36,484	33,732
Female	49.6% (50.0)	51.1% (50.0)	50.5% (50.0)	50.7% (50.0)
Nonwhite	63.5% (48.2)	59.8% (49.0)	68.5% (46.5)	64.3% (47.9)
Free lunch eligibility, bldg.[a]	50.7% (29.0)	48.9% (28.3)	56.8% (26.3)	57.2% (26.0)
Nonwhite enrollment, bldg.[a]	60.0% (38.5)	58.8% (38.7)	63.9% (35.1)	64.0% (35.7)
Average enrollment, bldg.	276 (201)	282 (203)	430 (191)	431 (192)
Ave. pupil/teacher ratio, bldg.	19.0 (4.4)	19.0 (4.4)	22.6 (3.8)	22.5 (3.9)
Average teacher salary, dist.[a]	$31,185 (7851)	$31,399 (7977)	$47,315 (5885)	$47,443 (5955)
Ave. expenditure/pupil, dist.	$6,462 (1924)	$6,458 (1962)	$7,051 (1058)	$7,058 (1054)
Mean math (science) score	516.9 (31.6)	368.5 (34.2)	531.2 (31.2)	379.7 (35.6)
Mean reading (writing)[b] score	307.6 (26.3)	2.24 (0.44)	314.0 (25.0)	2.32 (0.48)

[a] Sample size is reduced because of missing values.
[b] Writing tests were graded with 4-classification rubric, and so grades take on values between one and four.

Table 2 Coefficients from a Model Explaining Test Score Levels Using Preferred Specification, 1998/99 (absolute value of *t*-statistics in parentheses)

Characteristic	4th Grade Reading	5th Grade Science
PSA (=1)	-0.027	-0.043
	(14.27)	(24.63)
Student Characteristics		
Female	0.017	0.001
	(21.73)	(1.51)
Nonwhite	-0.021	-0.042
	(17.83)	(29.35)
Building Characteristics		
Percentage free or reduced price lunch	-0.006	-0.0009
	(24.47)	(29.83)
Enrollment (log)	-0.008	-0.009
	(6.74)	(6.09)
Pupil/teacher (log)	-0.009	-0.009
	(3.15)	(2.50)
District Characteristics		
Expenditure per pupil	0.021	0.006
	(4.09)	(0.89)
Fixed effects	Yes	Yes
$\overline{R}^2$	0.089	0.143
Sample size	39,259	35,896

Note: Table entries are coefficients from an OLS regression of log test score levels. Observations for which percentage free or reduced price lunch was missing used sample mean percentage. This highly inflates the *t*-statistics on that variable.

Table 3 **Impact Estimates of Enrollment in Charter Schools on Test Score Levels, by Year** (absolute value of *t*-statistics in parentheses)

Year	4th Grade		5th Grade	
	Math	Reading	Science	Writing
1996/97	-0.031	-0.014	-0.033	-0.070
	(7.93)	(2.78)	(5.80)	(4.42)
1997/98	-0.027	-0.018	-0.041	-0.070
	(12.38)	(6.01)	(12.55)	(7.28)
1998/99	-0.033	-0.027	-0.043	-0.059
	(24.09)	(14.31)	(17.76)	(10.94)
Pooled 1996/97 – 1998/99	-0.031	-0.025	-0.042	-0.069
	(28.68)	(16.64)	(24.21)	(14.98)

Note: Table entries are coefficients from an OLS regression of log test score levels on a dummy variable that is set to 1 for PSA enrollment, 0 otherwise. Other independent variables include student race = nonwhite; student sex; building percentage eligibility for free or reduced price lunch; log building enrollment; log building pupil/teacher ratio; log district expenditure per pupil; district fixed effects; and test year (for pooled year estimates). Observations for which percentage free or reduced price lunch was missing used sample mean percentage. Sample sizes for each cell of the table are approximately 30,000 for the individual years and 90,000 for the pooled sample, and adjusted R^2 values range from 0.05 to 0.14.

Table 4 **Indirect Impact Estimates of Presence of Charter School in District on Test Score Levels, by Year** (absolute value of *t*-statistics in parentheses)

	4th Grade		5th Grade	
Year	Math	Reading	Science	Writing
Estimated with District Fixed Effects				
Pooled 1996/97 - 1998/99	-0.0012 (2.08)	-0.0005 (0.67)	0.0015 (6.54)	0.0158 (5.73)
No Fixed Effects				
1996/97	0.002 (2.88)	0.010 (13.94)	0.007 (10.63)	-0.002 (0.82)
1997/98	0.001 (2.13)	0.003 (4.88)	0.006 (10.33)	-0.008 (9.27)
1998/99	-0.002 (4.51)	-0.001 (1.86)	-0.003 (4.72)	-0.003 (1.59)
Pooled 1996/97 - 1998/99	0.000 (0.20)	0.003 (9.21)	0.003 (7.84)	-0.004 (3.81)

Note: Table entries are coefficients on dummy variable set =1 if PSA located in district; 0 otherwise from an OLS regression of log test score levels *estimated for students enrolled in traditional public schools only*. Other independent variables include student race = nonwhite; student sex; building percentage eligibility for free or reduced price lunch; log building enrollment; log district expenditure per pupil; district fixed effects (upper panel); and test year (for pooled year estimates). Sample sizes are approximately 110,000 for each year of the data, and 330,000 for the pooled sample. Adjusted R^2 values range from 0.05 to 0.13.

Table 5 **Impact Estimates of Enrollment in Charter Schools on Test Score Levels and the Trend in Impact Estimates** (absolute value of *t*-statistics in parentheses)

Variable	4th Grade		5th Grade	
	Math	Reading	Science	Writing
PSA = 1	-0.047	-0.048	-0.075	-0.113
	(16.36)	(12.35)	(15.20)	(8.71)
PSA × yrs. since opening	0.007	0.009	0.010	0.009
	(8.42)	(7.53)	(6.99)	(2.27)

Note: Table entries are coefficients from an OLS regression of log test score levels. Sample was pooled over all three years of the data. Other independent variables include student race = nonwhite; student sex; building percentage eligibility for free or reduced price lunch; log building enrollment; log building pupil/teacher ratio; log district expenditure per pupil; and district fixed effects. Observations for which percentage free or reduced price lunch was missing used sample mean percentage. Sample sizes for each cell of the table are approximately 90,000, and adjusted R^2 values range from 0.07 to 0.12.

Table 6 **Impact Estimates of Enrollment in Charter Schools on Test Score Levels, by Year and by Whether the Charter School is Run by an EMO**
(absolute value of *t*-statistics in parentheses)

Year	4th Grade		5th Grade	
	Math	Reading	Science	Writing
1996/97, charter is managed by EMO	-0.032	-0.016	-0.041	-0.092
	(7.96)	(2.95)	(7.00)	(5.55)
1996/97, charter is not managed by EMO	-0.025	-0.007	0.002	0.020
	(3.69)	(0.75)	(0.23)	(0.79)
1997/98, charter is managed by EMO	-0.027	-0.019	-0.041	-0.070
	(11.75)	(5.40)	(11.63)	(6.68)
1997/98, charter is not managed by EMO	-0.026	-0.016	-0.040	-0.071
	(7.76)	(3.33)	(7.85)	(4.67)
1998/99, charter is managed by EMO	-0.035	-0.031	-0.047	-0.068
	(24.25)	(15.46)	(18.28)	(11.67)
1998/99, charter is not managed by EMO	-0.022	-0.009	-0.024	-0.022
	(8.38)	(2.38)	(5.01)	(2.09)
Pooled 1996/97 – 1998/99, charter is managed by EMO	-0.033	-0.027	-0.046	-0.076
	(28.27)	(17.21)	(24.47)	(15.47)
Pooled 1996/97 – 1998/99, charter is not managed by EMO	-0.025	-0.014	-0.028	-0.039
	(12.39)	(5.20)	(8.73)	(4.66)

Note: Table entries are coefficients from an OLS regression of log test score levels. Other independent variables include student race = nonwhite; student sex; building percentage eligibility for free or reduced price lunch; log building enrollment; log building pupil/teacher ratio; log district expenditure per pupil; district fixed effects; and test year (for pooled year estimates). Observations for which percentage free or reduced price lunch was missing used sample mean percentage. Sample sizes for each cell of the table are approximately 30,000 for the individual years and 90,000 for the pooled sample and adjusted R^2 values range from 0.05 to 0.14.

Table 7 **Impact Estimates of Enrollment in Charter Schools on Test Score Levels for Nonwhite Students and Building Poverty**
(absolute value of *t*-statistics in parentheses)

Characteristic	4th Grade		5th Grade	
	Math	Reading	Science	Writing
PSA = 1	-0.021 (7.73)	-0.011 (3.02)	-0.028 (6.31)	-0.038 (3.20)
PSA × Free lunch percentage	-0.0001 (1.45)	-0.0001 (1.27)	0.0000 (0.04)	-0.0007 (2.98)
PSA × Nonwhite	-0.013 (2.72)	-0.004 (0.60)	-0.001 (0.19)	0.003 (0.14)
PSA × Nonwhite × Free lunch percentage	0.0000 (0.38)	-0.0002 (1.79)	-0.0005 (3.41)	0.0001 (0.24)

Note: Table entries are coefficients from an OLS regression of log test score levels. Sample was pooled over all three years of the data. Other independent variables include student race = nonwhite; student sex; building percentage eligibility for free or reduced price lunch; log building enrollment; log building pupil/teacher ratio; log district expenditure per pupil and district fixed effects; and test year. Observations for which percentage free or reduced price lunch was missing used sample mean percentage. Sample sizes for each cell of the table are approximately 90,000, and adjusted R^2 values range from 0.05 to 0.12.

Table 8 **Impact Estimates of Enrollment in Charter Schools on Fifth Grade Test Score Levels for Nonwhite Students and Building Poverty, Controlling for Fourth Grade Pre-tests** (absolute value of *t*-statistics in parentheses)

Characteristic	Specification 1		Specification 2	
	Science	Writing	Science	Writing
PSA = 1	-0.022 (6.02)	-0.042 (4.52)	-0.016 (1.41)	-0.022 (0.80)
PSA × Free lunch percentage			0.0002 (0.65)	-0.0002 (0.32)
PSA × Nonwhite			-0.008 (0.41)	-0.064 (1.39)
PSA × Nonwhite × Free lunch percentage			-0.0004 (1.20)	0.0008 (0.87)

Note: Table entries are coefficients from OLS regressions of log 1998/99 test score levels. Other independent variables include log 1997/98 test scores, student race = nonwhite; student sex; building percentage eligibility for free or reduced price lunch; log building enrollment; log building pupil/teacher ratio; log district expenditures per pupil; log pretest score; and district fixed effects. Observation for which percentage free or reduced price lunch was missing used sample mean percentage. Sample sizes for each column of the table are approximately 10,000, and adjusted R^2 values range from 0.16 to 0.36.

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