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ABSTRACT

Proponents of school reform have argued that charter schools and vouchers can provide adequate market pressure to improve the performance of traditional public schools. While the number of charter schools and student enrollment have burgeoned, relatively little attention has been paid to their effects on student achievement. Proponents of charter schools suggest a direct effect on student achievement through the restructuring of teaching and learning processes and an indirect effect through peer effects on learning and through the market forces of competition. Of course, competitive pressures may result in higher achievement in traditional public schools as well.

This paper focuses on student achievement in charter schools in Michigan. The analyses presented in the paper 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. 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). 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 (MDE's) website. Five years of MEAP scores—from 1996/97 through 200/01—for individual fourth and fifth grade students are analyzed.

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. Several models of the difference between test score levels of students attending charter schools versus those from traditional public schools are estimated.

In virtually all specifications, each of which controls for student, building, and district characteristics, students attending charter schools have lower test scores than students in traditional public schools. The magnitudes of the results vary by grade, year, and subject matter, but are generally on the order of 3–10 percent. We argue that our estimates of the negative differentials may be biased toward zero because we have not controlled for selection bias.

Impact of Charter School Attendance on Student Achievement in Michigan

Proponents of school reform have argued that charter schools and vouchers can provide adequate market pressure to improve the performance of traditional public schools.[1] 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, Texas, and Michigan have led the movement, accounting for about 50 percent of those schools and over half of the students. 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 the 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 an impediment to the learning process. Charter schools give them the opportunity to implement these innovations or remove the obstacles, and thus to enhance student learning directly. 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

[1]Gill et al. (2001) provide an exhaustive review of school improvement initiatives that rely on choice mechanisms such as vouchers or charter schools.

are complementary to learning, then student performance in charter schools will exceed achievement in traditional public schools. In addition, the necessity of competing for 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.[2]

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. 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.[3] On the one hand, this result is not too surprising because the charter schools are a reasonably 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, even though this is illegal.

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

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[2]See Hoxby (2002) for an analysis of the effects of charter school competition on public schools.

[3]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 they receive the same state foundation grant on a per-pupil basis as do traditional public schools. Charter schools cannot charge tuition, but can raise funds through legal foundations and receive grants.

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. Unlike regular school board members, however, 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 hold teachers and administrators more accountable for educational achievement. The evaluation cited several shortcomings with respect to the current practices 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).[4] 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 the primary grades. The State makes the MEAP results available 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. Five years of MEAP scores for individual fourth and fifth grade students are available from 1996/97 through 2000/01.

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 five years of our data. Consequently, pooling the data over time is appropriate. 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 annual learning gains in specific subjects. Nonetheless, in one model specification, we control for pre-test achievement by using the student's MEAP

[4]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.

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 as a pre-test for the fifth grade writing. The results using gains are qualitatively the same as the results using levels. For the most part, however, we rely on analyses of test score levels.

The most rigorous way of determining the impact of charter school attendance on student test scores would be through an experimental design in which students were randomly assigned to attend a charter school or to attend a traditional public school. This, of course, is not feasible. So the analytical question becomes what comparison group to use for charter school students. 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. The ideal counterfactual would be those school districts and buildings that the charter school students would have attended if there were no charter schools. In practice, identifying these districts and buildings is difficult. Many of the charter school students come from private schools, and some come from home schooling. But even for students from public school backgrounds, charter schools are not limited to specific district boundaries, so charter schools may attract students from several districts, especially in urban or suburban areas.

No charter school administrative data report where students would have enrolled in the absence of charter schools. So we were left with the task of trying to identify a reasonable comparison group of students. Our approach has been to use two different methods, which we think are reasonable bounds to actual enrollment practices. The first approach, which we title "Charter-District" matches, uses students

from the local school districts that "house" the charters as a comparison group.[5] The assumption behind this approach is that charter schools enroll only students from the traditional public schools in the districts where they are located (with the few exceptions noted in the footnote). The second approach, which we title "Charter-ISD" matches uses all districts and school buildings in the intermediate school district where they are located. We provide empirical results using both approaches.

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. Reporting is very sporadic, however, 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.[6] 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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[5]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 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.

[6]For example, 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 in pursuing 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 attribute fully the test score to the current school of attendance if students have transferred into that school. Many 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.[7] 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

[7]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.

program and some charter schools list the MEAP test as their only evidence of student achievement (Horn and Miron, 1999, p. 83).[8]

We examine the MEAP test scores for all fourth and fifth grade students in charter schools, as well as in the public schools of districts and ISDs 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. Tables 1 and 2 provide descriptive statistics from the data set that we have constructed for fourth graders and for fifth graders, respectively. 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 at the elementary level, 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 9.4 percent of the fourth grade test takers (8.1 percent of the fifth graders) in the districts in our data set for the 2000/2001 school year.

Note that, in general, charter schools have smaller enrollments and smaller class sizes than public schools, although the differences are getting smaller over time as charter schools gain enrollment. In fourth grade for the latest year of data, the average building enrollment for charters was 356, which is about 87 percent of the average building enrollment in the traditional public schools. In both tables 1 and 2, the

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

earliest years of data show that the average student/teacher ratios for charter schools are between 18.1 to 18.6 for fourth and fifth graders. In the last year of data, these ratios have risen to over 19.0. On the other hand, the traditional public schools' average student/teacher ratios have declined over time from almost 24 to about 22. Note, however, that even in the most recent year of data, the pupil/teacher ratio in charter schools is about 80 percent of what it is in traditional public school.

The ethnicity and poverty status of students in the two types of schools were quite different in the earliest years of data, but have become more equal since. Using District matches, the percent of students eligible for free or reduced price lunches at the building level had been consistently 5– 10 percentage points lower for charter schools than for traditional public schools in the first four years of data, but was actually a few percentage points higher in 2000/01. Similarly, the building data from the MDE show quite significant nonwhite enrollment percentage differences between charter schools and traditional buildings (using district matches) for the first three years of data, but the percentages are virtually identical in the most recent year of data. Clearly, the ethnicity and poverty characteristics of charter schools more closely resemble the districts in which they are located than the ISDs. In all years and in both grades, the ISD percentages of students eligible for free or reduced price lunch and nonwhite students are much lower than the charter school percentages. There has been some concern about trends in the characteristics of charter school students toward majority ethnicity and non-poor economic status.[9] But our data do not confirm any such trend, and in fact, the free lunch eligibility percentage and the nonwhite building enrollment percentage are quite comparable to the traditional schools in the districts where the charter schools are located.

[9]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.

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 four years of the data for which salary information is available.[10] Similarly, average expenditures per pupil are lower in charter schools, although the gap between charters and traditional public schools in average expenditures per pupil is not very large (between 5–10 percent). 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 533 for fourth graders in traditional public schools and about 519 for fourth graders in charter schools. The averages for fifth graders for science are about 383 and 372, respectively. When we examine the differences using the Charter-ISD matches, the differences in test scores are even bigger.

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

[10]Due to reporting lags, the district financial variables–average teacher salary and average expenditures per student are not yet available for the 2000/2001 school year.

with public school districts (or ISDs), 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 (or ISD).

We consider the MEAP test scores of fourth and fifth graders for five school years, 1996/97 through 2000/2001. Test scores (in log form) 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.

The second set of variables relates to school environment. We include the building-level pupil/teacher ratio and enrollment in logs. Our expectation is that both of these variables will be negatively related to test scores—larger class sizes impede instructional effectiveness, and larger schools (controlling for larger class sizes) will tend to have lower achievement. The third building-level variable that we have used is the percentage of students eligible for free or reduced price lunch. This variable is our measure of poverty, and a considerable number of studies have found strongly negative causality between poverty and student achievement levels.

The third set of variables, measured at the district level, 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.[11] Expenditures per pupil proxy the amount of school-based resources available at the building level. Our *a priori* expectation is that both of these variables will be positively related to test scores.

In the estimates discussed below, the coefficients on these three sets of variables generally have the expected signs and are statistically significant, both 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 3 provides the estimates from our preferred model specification, with fixed effects, using 1999/2000 school-year data for reading (fourth grade test) and for science (fifth grade test), and using both the district match and ISD match for constructing the comparison groups. We present those results because that is the most recent year for which we have the district financial data.

The table shows that among the personal characteristics that are available on the data set, female students outperform males by about one percent on the reading test, and achieve virtually the same scores on average on the science test (the differences are negative and statistically significant, but less than one-half percentage point). Nonwhites score about 2–3 percent lower on the reading test and about 3–4 percent lower on the science test than white students.

The building characteristics are generally all significant and of the expected negative sign. The free lunch eligibility percentage, building enrollment, and pupil/teacher ratio in the building are all negatively

[11]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.

associated with reading and science scores (the exception is building enrollment for the district-matched data for reading and ISD-matched data for science). The free lunch eligibility percentage variable is scaled to be between 0 and 1, so the mean school, which is about 50 percent in both traditional public schools and charter schools, has student scores that are about 3–5 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 point estimates—which are elasticities—suggest a fairly small effect. A five percent increase in expenditures per pupil, which translates to about $350, is predicted to increase reading test scores by about 1/4th percent, or about 1 point on average.

In the models presented in table 3 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 4 provides impact estimates from our basic specification for each of the four tests from each year plus for the data pooled together for both the "charter-district" and "charter-ISD" matches. 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 two to three percent lower on reading and math tests; the fifth grade students in PSAs scored about three to four percent lower on the science test and about five to nine 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. In an earlier paper (Eberts and Hollenbeck, 2001), we reported the results of tests for such an indirect effect. Specifically, we used three years of MEAP test score data and 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 showed that fifth grade students in districts that "host" a charter school scored about one and one-half percent higher on the writing test than students from other districts, controlling for student, building, and district characteristics and about 0.15 percent higher on the science test. But fourth grade students did not score higher on the math or reading tests.

Since some PSAs enroll only students in grades K-4, one would hypothesize that the indirect "threat" effect would be stronger in fourth grade, but the fourth grade effect was null. The results suggested that, if anything, the effect occurs in fifth grade. However, the magnitude of the effect was a small fraction of the size of the impact estimate and the trend in the "threat" effect exhibited a decrease over time. All in all, we concluded 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. However, table 4 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, but only by about 0.3–0.5 percent per year for each of the tests. If this trend continued in a linear trajectory, it would then take about 10–13 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 (an educational management organization, or EMO) and the other indicating whether or not the PSA is managed by some other entity. The two variables are mutually exclusive and together represent the entire group of PSAs that are in the previous analysis. The results show that, in the early years of data, PSAs managed by for-profit companies have lower test scores relative to public schools than do PSAs not managed by for-profits. However, in the last two years of data, the result is reversed. Students at PSAs

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

managed by EMOs still do worse than students from traditional public schools, but the students at PSAs not managed by EMOs do even worse. For virtually all of the tests, the five-year trends decrease in magnitude for the EMO sample and increase in magnitude for the non-EMO sample. The results for the later years are consistent with the hypothesis that more business-like management practices yield better student performance, as measured by test score levels, assuming that schools run by 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 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- 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 three 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.[13,14] Table 7 presents the results from these estimations with fourth grade scores from 1998/1999

[13]The procedures that we followed for matching students from 4th to 5th 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.

[14]The (zero-order) correlations between the 4th grade reading test score and the 5th grade writing test score, and between the 4th grade math test score and the 5th grade science test score, were on the order of 0.76.

used as pretests for 1999/2000.[15] The negative impacts for science and writing were attenuated slightly from what is reported in table 4. The science disadvantage decreased from about 3.2 percent to 1.6 percent, and the writing disadvantage declined from 7.8 percent to about 7.2 percent.

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 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 similar percentages of students eligible for free or reduced price lunch program and of minority ethnicity, 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.

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.

[15]This is the most recent year of data for which the match could be accomplished because the state no longer reports date of birth.

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.

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Table 1 Descriptive Statistics for Selected Student, Building, and District Characteristics, 4th Grade

	96/97			97/98			98/99			99/00			00/01		
	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)
Number of schools/districts	30	324/25	993/183	62	448/42	1156/249	91	528/52	1285/303	119	632/64	1449/331	119	717/69	1462/314
Number of students	724	12,424	49,588	1,611	17,569	56,237	2,733	20,874	63,136	4,036	27,141	76,440	4,421	42,779	89,711
Female	48.3%	50.6%	50.0%	50.0%	51.3%	50.7%	49.8%	50.5%	50.3%	50.7%	50.7%	50.4%	51.0%	50.9%	50.4%
Nonwhite	58.3%	61.5%	29.7%	58.4%	50.0%	27.5%	62.9%	51.7%	27.1%	63.8%	48.1%	25.1%	65.4%	56.0%	33.8%
Free lunch eligibility, bldg.[a]	51.7%	59.6%	39.0%	49.0%	55.3%	39.6%	51.2%	56.5%	39.9%	49.9%	54.8%	37.8%	54.4%	51.5%	38.1%
Nonwhite enrollment, bldg.[a]	42.4%	65.2%	33.4%	48.0%	55.9%	32.8%	52.5%	56.6%	31.9%	53.5%	54.1%	30.0%	52.7%	52.5%	31.9%
Average enrollment, bldg.	197.9	470.1	436.3	241.4	440.3	420.0	273.6	420.3	408.9	314.9	409.2	404.3	356.4	410.1	402.2
Average pupil/ teacher ratio, bldg.	18.3	23.6	23.8	18.3	23.3	23.4	18.7	22.3	22.4	18.9	21.5	21.7	19.1	22.0	21.8
Average teacher salary, dist.[a]	$31,317	$47,133	$48,679	$32,310	$47,606	$47,214	$31,314	$47,657	$47,169	$34,974	$49,058	$48,263	NA	NA	NA
Avg. expenditure/ pupil, dist.	$5,967	$6,245	$6,116	$5,974	$6,419	$6,096	$5,899	$6,775	$6,266	$6,255	$7,096	$6,657	NA	NA	NA
Mean math score	506.7	522.7	529.5	522.5	535.4	539.0	517.3	532.2	538.0	516.5	536.3	541.4	518.9	532.7	538.4
Mean reading score	304.0	310.9	313.7	309.8	316.1	318.4	307.8	314.9	318.5	303.6	314.1	317.6	305.3	313.1	316.1

[a] Sample size is reduced because of missing values.

NA = Data not yet available.

Table 2 Descriptive Statistics for Selected Student, Building, and District Characteristics, 5th Grade

	96/97			97/98			98/99			99/00			00/01		
	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)	Charter Schools	Traditional (District Match)	Traditional (ISD Match)
Number of schools/districts	36	343/27	946/184	58	434/39	1127/239	86	510/50	1252/297	116	627/64	1420/334	121	702/70	1415/318
Number of students	616	13,294	47,959	1,330	18,641	59,224	2,073	21,018	65,664	3,221	27,942	77,612	3,920	44,332	94,329
Female	47.9%	50.3%	49.5%	53.2%	50.4%	49.6%	50.9%	50.2%	49.9%	49.7%	50.2%	49.8%	51.9%	50.5%	50.1%
Nonwhite	54.1%	51.8%	27.7%	57.4%	50.9%	29.0%	58.1%	49.6%	26.9%	63.2%	49.4%	26.0%	65.9%	56.5%	33.7%
Free lunch eligibility, bldg.[a]	51.7%	57.3%	39.8%	47.4%	57.3%	40.5%	49.4%	57.4%	40.3%	49.6%	55.8%	38.0%	54.3%	52.3%	38.3%
Nonwhite enrollment, bldg.[a]	46.4%	60.3%	33.8%	46.7%	59.4%	34.2%	51.5%	57.3%	32.8%	52.6%	55.9%	31.0%	53.4%	53.3%	32.4%
Average enrollment, bldg.	195.1	465.1	438.1	247.4	440.5	424.8	280.7	423.2	415.4	316.3	415.0	411.4	361.0	412.2	407.1
Average pupil/ teacher ratio, bldg.	18.6	23.3	23.7	18.1	23.2	23.3	18.8	22.2	22.4	18.6	21.4	21.7	19.3	22.2	21.9
Average teacher salary, dist.[a]	$30,402	$47,449	$48,624	$31,781	$47,285	$47,425	$31,529	$47,809	$47,215	$34,872	$49,057	$48,294	NA	NA	NA
Avg. expenditure/ pupil, dist.	$5,776	$6,255	$6,106	$6,027	$6,393	$6,125	$5,887	$6,779	$6,302	$6,268	$7,096	$6,660	NA	NA	NA
Mean science score	372.0	385.4	389.3	375.6	387.3	390.3	367.8	382.0	388.2	372.6	389.2	394.9	372.5	383.4	390.6
Mean writing[b] score	2.45	2.57	2.67	2.41	2.48	2.57	2.23	2.35	2.43	2.28	2.48	2.55	2.20	2.41	2.46

[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.

NA = Data not yet available.

Table 3 Coefficients from a Model Explaining Test Score Levels Using Preferred Specification, 1999/2000

(absolute value of *t*-statistics in parentheses)

	4th Grade Reading		5th Grade Science	
Characteristic	District Match	ISD Match	District Match	ISD Match
PSA (=1)	–0.021 (11.02)	–0.028 (21.82)	–0.032 (14.08)	–0.037 (24.34)
Student Characteristics				
Female	0.011 (13.73)	0.010 (19.36)	–0.003 (2.90)	–0.006 (10.50)
Nonwhite	–0.027 (24.03)	–0.022 (28.91)	–0.044 (35.83)	–0.032 (43.11)
Building Characteristics				
Percentage free or reduced price lunch	–0.059 (21.29)	–0.064 (48.94)	–0.086 (28.65)	–0.080 (55.69)
Enrollment (log)	0.0009 (0.69)	0.0018 (2.31)	–0.0082 (5.25)	–0.0006 (0.75)
Pupil/teacher (log)	–0.011 (3.38)	–0.077 (3.85)	–0.013 (3.43)	–0.015 (6.75)
District Characteristics				
Expenditure per pupil (log)	0.047 (7.16)	0.038 (16.05)	0.054 (7.06)	0.043 (16.39)
Fixed effects	Yes	Yes	Yes	Yes
$\overline{R}^2$	0.1411	0.1063	0.2002	0.1496
Sample size	31,177	80,476	31,163	80,833

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

	4th Grade		5th Grade	
Year	Math	Reading	Science	Writing
		Charter – District Match		
1996/97	–0.028	–0.015	–0.037	–0.069
	(8.54)	(3.52)	(8.11)	(5.37)
1997/98	–0.026	–0.019	–0.035	–0.059
	(13.38)	(6.76)	(12.20)	(6.66)
1998/99	–0.026	–0.024	–0.040	–0.050
	(15.89)	(10.44)	(13.49)	(7.29)
1999/00	–0.022	–0.021	–0.032	–0.078
	(16.26)	(11.02)	(14.08)	(11.84)
2000/01	–0.021	–0.021	–0.024	–0.086
	(24.20)	(16.78)	(16.62)	(21.52)
Pooled,	–0.028	–0.026	–0.035	–0.075
1996/97—2000/01	(53.18)	(35.44)	(40.57)	(31.06)
		Charter – ISD Match		
1996/97	–0.036	–0.024	–0.040	–0.081
	(16.31)	(7.81)	(11.98)	(8.56)
1997/98	–0.026	–0.019	–0.030	–0.055
	(18.35)	(9.58)	(14.14)	(7.89)
1998/99	–0.027	–0.024	–0.036	–0.052
	(23.71)	(15.20)	(18.23)	(10.97)
1999/00	–0.029	–0.028	–0.037	–0.080
	(31.13)	(21.82)	(24.34)	(18.09)
2000/01	–0.028	–0.026	–0.029	–0.096
	(34.22)	(22.03)	(22.40)	(25.96)
Pooled,	–0.034	–0.030	–0.039	–0.086
1996/97—2000/01	(70.49)	(45.56)	(51.24)	(39.55)

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 in the "Charter – District" panel are approximately 30,000 for the individual years and 130,000 for the pooled sample, and adjusted R^2 values range from 0.08 to 0.19. Sample sizes for each cell of the table in the "Charter – ISD" panel are approximately 65,000 for the individual years and 350,000 for the pooled sample, and adjusted R^2 values range from 0.08 to 0.19.

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)

	4th Grade		5th Grade	
Variable	Math	Reading	Science	Writing
		District Matches		
PSA = 1	–0.040	–0.047	–0.050	–0.124
	(24.64)	(20.98)	(18.74)	(16.76)
PSA * yrs. since opening	0.003	0.005	0.003	0.011
	(7.86)	(9.92)	(5.80)	(6.77)
		ISD Matches		
PSA = 1	–0.036	–0.037	–0.043	–0.111
	(36.75)	(27.29)	(25.83)	(22.95)
PSA * yrs. since opening	0.001	0.002	0.001	0.005
	(3.66)	(6.08)	(3.40)	(5.16)

Note: Table entries are coefficients from an OLS regression of log test score levels. Sample was pooled over all five 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 in the upper panel of the table are approximately 130,000, and adjusted R^2 values range from 0.11 to 0.17. Sample sizes for each cell in the lower panel of the table are approximately 350,000 and adjusted R^2 values range from 0.09 to 0.15.

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)

	4th Grade				5th Grade			
	Math		Reading		Science		Writing	
Year	EMO	Non-EMO	EMO	Non-EMO	EMO	Non-EMO	EMO	Non-EMO
District Matches								
1996/97	–0.031	–0.016	–0.019	–0.001	–0.047	–0.012	–0.097	0.010
	(8.74)	(2.57)	(4.02)	(0.19)	(9.07)	(1.62)	(6.84)	(0.46)
1997/98	–0.027	–0.024	–0.020	–0.014	–0.035	–0.035	–0.059	–0.057
	(12.91)	(7.20)	(6.77)	(3.06)	(11.03)	(7.39)	(6.08)	(3.93)
1998/99	–0.029	–0.015	–0.028	–0.005	–0.044	–0.022	–0.058	–0.012
	(16.64)	(5.45)	(11.65)	(1.35)	(14.18)	(4.42)	(8.14)	(0.99)
1999/00	–0.024	–0.018	–0.023	–0.016	–0.028	–0.039	–0.075	–0.085
	(16.24)	(9.77)	(11.26)	(6.19)	(11.31)	(12.78)	(10.30)	(9.47)
2000/01	–0.020	–0.024	–0.019	–0.025	–0.021	–0.027	–0.084	–0.090
	(17.41)	(17.89)	(11.82)	(12.71)	(11.75)	(12.54)	(16.46)	(14.71)
Pooled,	–0.030	–0.026	–0.028	–0.023	–0.035	–0.035	–0.075	–0.074
1996/97–2000/01	(46.79)	(28.94)	(31.91)	(18.19)	(34.06)	(24.25)	(26.24)	(18.34)
ISD Matches								
1996/97	–0.038	–0.030	–0.027	–0.010	–0.048	–0.016	–0.108	0.004
	(15.58)	(5.81)	(8.04)	(1.40)	(12.61)	(2.49)	(10.06)	(0.21)
1997/98	–0.027	–0.021	–0.021	–0.011	–0.031	–0.028	–0.058	–0.038
	(16.94)	(7.86)	(9.40)	(2.86)	(12.76)	(6.70)	(7.39)	(2.80)
1998/99	–0.030	–0.014	–0.029	–0.003	–0.040	–0.018	–0.061	–0.018
	(24.37)	(6.26)	(17.04)	(0.85)	(18.67)	(4.58)	(11.66)	(1.84)
1999/00	–0.030	–0.027	–0.029	–0.025	–0.033	–0.044	–0.082	–0.076
	(27.21)	(18.62)	(19.44)	(12.52)	(18.10)	(18.65)	(15.50)	(11.01)
2000/01	–0.027	–0.031	–0.024	–0.029	–0.024	–0.035	–0.092	–0.101
	(25.10)	(24.33)	(15.72)	(16.19)	(14.64)	(17.95)	(19.33)	(17.97)
Pooled,	–0.034	–0.032	–0.031	–0.028	–0.038	–0.041	–0.088	–0.081
1996/97–2000/01	(60.07)	(39.37)	(39.60)	(24.21)	(41.25)	(31.88)	(33.55)	(22.00)

Note: Table entries are coefficients from an OLS regression of log tests 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 in the "District" panel are approximately 30,000 for the individual years and 130,000 for the pooled sample, and adjusted R^2 values range from 0.08 to 0.19. Sample sizes for each cell of the table in the "ISD" panel are approximately 65,000 for the individual years and 350,000 for the pooled sample, and adjusted R^2 values range from 0.08 to 0.19.

Table 7 Impact Estimates of Enrollment in Charter Schools on 5th Grade Test Score Levels in 1999/2000 Controlling for 4th Grade Pre-tests
(absolute value of *t*-statistics in parentheses)

	Charter–District Match		Charter–ISD Match	
Characteristic	Science	Writing	Science	Writing
PSA = 1	–0.016 (5.48)	–0.072 (7.57)	–0.011 (5.55)	–0.060 (9.27)

Note: Table entries are coefficients from OLS regressions of log 1999/2000 test score levels. Other independent variables include log 1998/1999 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 size for the "Charter–District" match in columns 1 and 2 is about 11,000 and adjusted R^2 are 0.48 and 0.20. Sample size for the "Charter–ISD" match in columns 3 and 4 is about 34,000 and adjusted R^2 are 0.46 and 0.18.