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Milwaukee Independent Charter Schools Study: Final Report on Four-Year Achievement Gains

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SCDP Milwaukee Evaluation
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The School Choice Demonstration Project (SCDP), based within the Department of Education Reform, is an education research center devoted to the non-partisan study of the effects of school choice policy and is staffed by leading school choice researchers and scholars. Led by Dr. Patrick J. Wolf, Professor of Education Reform and Endowed 21st Century Chair in School Choice, SCDP's national team of researchers, institutional research partners and staff are devoted to the rigorous evaluation of school choice programs and other school improvement efforts across the country. The SCDP is committed to raising and advancing the public's understanding of the strengths and limitations of school choice policies and programs by conducting comprehensive research on what happens to students, families, schools and communities when more parents are allowed to choose their child's school.

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SCHOOL CHOICE
DEMONSTRATION PROJECT

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EXECUTIVE SUMMARY

The general purpose of this five-year evaluation is to assess the effectiveness of Milwaukee's independent charter schools in promoting student achievement growth. Independent charter schools are authorized by non-school-district entities and are considered "independent" because they are not a part of the Milwaukee Public School District (MPS). Throughout the course of this report we will estimate four-year achievement gains for independent charter school students who were in grades 3-8 during the 2006-07 school year using reading and math achievement data from the Wisconsin Knowledge and Concepts Examination (WKCE). Specifically, the report presents the results of an analysis comparing achievement gains of independent charter students to the achievement gains of a carefully matched sample of students attending MPS.

This report draws upon a panel of 2,295 students attending 10 of Milwaukee's 14 independent charter schools who were in grades 3-8 in 2006-07 with test scores for that year. The four charter schools excluded from the sample either were not open for both the baseline and outcome years or did not enroll students in tested grades. The 2,295 tested Milwaukee independent charter school students were carefully matched to an identically sized sample of students attending MPS to provide a comparison group against which the achievement gains of independent charter students could be assessed. Students were matched on prior achievement and propensity scores, which help to control for differences between students on observable characteristics. We are confident our matching algorithm produced a charter and MPS sample equivalent on prior achievement. However, similar to other observational studies, our study is unable to control for all potential sources of unobservable selection bias. We believe this potential threat is less of a concern because highly motivated parents in MPS, similar to parents of charter school students, have many alternative options to exercise choice within the Milwaukee Public School system.

The results of the comparisons on math and reading scores differ by years and by the statistics employed. We reported last year that there was:

> …a clear pattern of positive charter school effects growing over time. There was little consistent evidence of differences in achievement gains between charter and MPS students after one year. The second year growth was better for charters in some models and for some tests, but not for others. In the third year of growth, a sizable independent charter school advantage was apparent in all of our analyses (Witte *et al.*, 2011).

That trend was not continued in the fifth year where estimates of four-year achievement growth are positive for charter schools but the basic models do not produce statistically significant differences between students

attending all independent charters and the MPS sample of students. On the other hand, students in conversion charters schools, which were once private schools, consistently outperformed similar MPS students in the matched sample in every year. In one model, the larger growth in math after five years is positive but not quite statistically significant.

One of our supplementary analyses determined that students who remained in charter schools over five years (e.g. "stayers") made significant achievement gains in both reading and math compared to their counterpart stayers in MPS. This finding holds for charter schools on average, as well as for conversion and non-conversion charter schools. These results are between three- and four-tenths of a standard deviation and significant at the 99 percent confidence level.

This project has been funded by a diverse set of philanthropies including the Annie E. Casey, Joyce, Kern Family, Lynde and Harry Bradley, Robertson, and Walton Family foundations. We thank them for their generous support and acknowledge that the actual content of this report is solely the responsibility of the authors and does not necessarily reflect any official positions of the various funding organizations, the University of Arkansas, or the University of Wisconsin. We also express our gratitude to officials at MPS, the independent charter schools, and the state Department of Public Instruction for their willing cooperation, advice, and assistance. We are appreciative of the constructive comments on a preliminary draft from outside experts as well as the School Choice Demonstration Project Research Advisory Board and research team. All remaining errors are the responsibility of the authors alone.

INTRODUCTION

Charter Schools

Charter schools are tuition-free public schools that are authorized to operate within an agreed "charter." Charters often specify the size of the school, its mission, specialized curricula and pedagogy, unique personnel practices, and specific goals that the school must meet over time in order to be reauthorized. Most charter schools use an open enrollment system that permits students to attend the school even if they do not live close by. Thus, charter schools are subject to parental school choice. To facilitate these unique schools, they are often given waivers from some of the administrative and accountability requirements of other public schools. This does not exempt charter schools from the testing and reporting requirements of the federal No Child Left Behind law.

Since the opening of the first charters schools in the US in the early 1990s, the number of charter schools has dramatically increased. In 2010, over 5,000 charter schools serving close to 1.7 million students operated in 40 states and the District of Columbia (Center for Education Reform, 2011). Following the recent "Race to the Top" initiative, which requires states to relax laws restricting the creation of charter schools, we can expect to see even further expansion of charter schools in the coming years.

Similar to national trends, the number of charter schools in Wisconsin has grown widely, from 17 in 1997 to 206 in 2010 (Evers *et al.,* 2010). Charter schools in 2010 served 37,000 students in the state (School Management Services, 2011). Government officials see the potential of charter schools as part of a reform to transform public education in the state. For the first time, Governor Jim Doyle and State Superintendent Tony Evers attended the Wisconsin Charter Schools Conference in April, 2009 (Borsuk, 2009). In October of 2009, President Barack Obama and Education Secretary Arne Duncan visited Wright Middle School, a charter school in Madison, to highlight the role of charter schools in the "Race to the Top" initiative. Wisconsin has also received $86 million in federal funding over the next five years to support charter schools in Milwaukee and the state by allocating grants to new and existing charter schools.

In Milwaukee, charter schools are one among a wide variety of school choice options including charter and magnet schools affiliated with MPS, open enrollment into other public school districts, and private schools accepting vouchers under the Milwaukee Parental Choice Program. In 2006-07, charter schools in Milwaukee comprised close to a quarter of the charter schools in the state.

This longitudinal study evaluates the impact of independent charter schools on student achievement in Milwaukee, Wisconsin over five years. Milwaukee is one of the few places in the U.S. that contains both district-authorized charter schools and independent charter schools. As of 2006-07, 38 district-authorized charter schools were part of the Milwaukee Public School system. Of these 38 district-authorized charters, a total of 25 were staffed by teachers who remain employees of the school district and bound by the union-negotiated

collective bargaining agreement (Table 1). These schools are referred to as "instrumentality" charters. The remaining 13 MPS "non-instrumentality" charter schools are permitted to hire and employ non-union teachers. This study does not evaluate district-authorized charters.

Table 1. Types of Public Charter Schools in Milwaukee, WI, 2006-2007

Type	Number	Percentage of All
MPS Instrumentality	25	48.1
MPS Non-Instrumentality	13	25.0
MPS Total	38	73.1
Independent U of W-Milwaukee	9	17.3
Independent City of Milwaukee	5	9.6
Independent Total	14	26.9

Source: Wisconsin Charter Schools Yearbook 2006-2007
http://dpi.state.wi.us/sms/pdf/2006-07yearbook.pdf

Independent charters are a distinctive type of charter school in Milwaukee. They were created by 1997 legislation to be authorized by the City of Milwaukee Common Council, the University of Wisconsin-Milwaukee (UWM), the Milwaukee Area Technical College, or the University of Wisconsin at Parkside (Racine). They are not connected to MPS, and they are non-instrumentality charter schools (hence they are not unionized). Of the 9 UWM and 5 City of Milwaukee independent charters open when this study began in 2006-07, 10 are the subjects of this research. Table 2 presents the student enrollments by grade for the baseline year of 2006-07 for our school sample and an explanation for excluded schools. As is apparent, UWM charter schools have many more students than City charters, and there are very few students in grade 9 compared to grades 3 to 8.[1]

Table 2. Milwaukee Independent Charter School Sample Enrollment, 2006-07

Grade	Schools	3	4	5	6	7	8	9	TOTAL
UWM	6	328	331	338	287	241	239	140	1904
City	4	92	89	99	88	119	80	58	625
TOTAL	10	420	420	437	375	360	319	198	2529

Source: Charter Schools page on the Department of Public Instruction website: http://www.dpi.state.wi.us/sms/xls/0607enrl.htm

Note: For the 2006-07 baseline year, there are no test score data for structural reasons for the following schools: Inlands Sea School of Expeditionary Learning (ISSEL), Milwaukee Renaissance Academy (MRA), Seeds of Health (SoHE), School for Early Development (SEDA), and Massai Institute which has closed as of 2007-08. For the first four schools, they did not test in November 2006 when schools typically test because they were not yet open. ISSEL opened in 01/2006, MRA in 08/2007, and SoHE in 08/2007. SEDA is an early education school with grade levels K4-2 and does not have data for grades 3-8, or grade 10 because it does not have these grade levels at its school. Bruce Guadalupe Community School transitioned from the oversight of MPS to being authorized as a charter by UWM in 2009-2010. In addition, in the 2010-2011 school year, the City chartered King's Academy while UWM chartered Urban Day School, Veritas High School and a new campus of Milwaukee College Preparatory School, Lindsay Heights. Many of the students attending Lindsay Heights formerly attended the Academy of Learning and Leadership which closed in September 2010.

1 Ninth grade students are not included in this study because tests were not given in the ninth grade.

Research on Charter Schools

Supporters see the potential of high-quality charter schools to help transform the education system by raising achievement levels, closing achievement gaps, placing competitive pressure on traditional public schools and stimulating greater innovation. They posit that giving charter schools more flexibility over such practices as hiring teachers, budgeting school funds, and selecting curricula will lead to these positive outcomes (Finn, Manno, & Vanourek, 2001; Payne & Knowles, 2009). Further, through a system of accountability, they expect to reduce the number of low-quality charter schools that are not able to meet the standards they agreed to in their charters.

In contrast, critics are concerned about charter schools drawing away resources from traditional public schools (e.g. teachers, funding, and motivated students), increasing racial segregation, and lacking the accountability structure to close or improve low-quality charter schools (Wells *et al.,* 2002). They fear charters are performing no better and sometimes worse than traditional public schools. To date the research on the performance of charter schools is somewhat mixed, ranging from negative, neutral, mildly positive, to a few specific studies which are strongly positive (Bifulco & Ladd, 2006; Sass, 2006; Ballou *et al.,* 2006; Hanushek *et al.,* 2007; Booker *et al.,*2007; Zimmer *et al.,* 2009; Witte *et al.,* 2007; Witte & Lavertu, 2009; CREDO, 2009; Hoxby *et al.,*2009; CREDO, 2010; Abdulkadiroglu *et al.,* 2009; Tuttle *et al.*, 2010; Gleason *et al.,* 2010).

Most of these prior studies are observational, with a smaller number of studies employing randomized experimental designs. While randomized experiments are recognized as producing gold standard results, they are costly and logistically less feasible than securing existing longitudinal data used in observational studies. In general, where there have been positive or negative impacts of charter schools, they have typically been small in magnitude (Hill *et al.,* 2006). The exceptions to this general trend are some more recent randomized trials of charter schools in Boston and New York (Abdulkadiroglu *et al.,* 2009; Hoxby *et al.,* 2009) and an observational study of those charters affiliated with the Knowledge is Power Program (KIPP) (Tuttle *et al.,* 2010) which find strong positive charter impacts. Research on charter impacts in Milwaukee more closely resembles the general trend of charter school performance, with two prior observational studies showing modestly positive gains in math for charter schools authorized by the Milwaukee Public Schools (Witte *et al.,* 2007; Witte & Lavertu, 2009). Our report of one year student achievement growth of students in Milwaukee independent charter schools found little difference in achievement between these schools and MPS schools (Witte *et al.,* 2010). However, the report highlighted that students in conversion charter schools – i.e. formerly private schools – did have more positive achievement growth than students in traditional MPS schools. Our analysis of two- and three-year growth of Milwaukee charter students compared to MPS students, also released previously, reported a charter school advantage that was somewhat larger and more consistent than the results of the initial analysis (Witte *et al.*, 2011).

In this report, we extend our previous charter school studies and evaluate four-year achievement gains. Using five years of panel data—2006-07 to 2010-11—we estimate models of achievement gains for charter school students who were in grades 3 through 8 at baseline (2006-07), relative to similar students in MPS, controlling for baseline test scores and student characteristics.

RESEARCH QUESTIONS AND METHODOLOGY

Research Question

Through this evaluation we endeavor to understand whether students benefit in the short term and the long term from attending an independent charter school. In this report the primary research question is: Do Milwaukee's independent charter schools produce greater four-year achievement gains than Milwaukee public schools? For purposes of this study, achievement is measured by performance on the reading and mathematics sections of the Wisconsin Knowledge and Concepts Examination (WKCE) that all public school students are required to take in grades 3 to 8 and 10 (Wisconsin Department of Public Instruction, 2011b). The WKCE is administered in the fall of each school year and uses short answer and multiple choice questions to test student mastery in reading, math, language arts, science and social studies. Scores on these examinations are recorded in both scale (or developmental) scores and proficiency levels. We rely on scale scores in this analysis. As indicated below, we standardize these scale scores in order to allow comparisons across grade levels. Student test scores and demographic characteristics used in this study were provided by the Office of Research and Evaluation at MPS, the Office of Charter Schools at the University of Wisconsin-Milwaukee, and the City of Milwaukee Common Council.[2]

Matched Samples

The first step in our analysis involved constructing the comparative samples of students. Because the total number of students in independent charters for which test scores were available in 2006-07 was 2,295, we decided to include all of those students in the charter school sample. The issue was then how to create a relevant matched sample that would be similar on important observed characteristics at baseline. To do that we first selected a random sample of MPS students matched by grade. In doing so we discovered that the baseline test scores (November 2006) for that group differed from those in the independent charter schools in a number of grades. The random MPS sample of students usually scored higher than the independent charter students. Thus, if we had used the random sample we would have started out with students at different levels of prior achievement.

To adjust for this problem we undertook a two-step procedure.[3] First, each student in the charter sample was grouped with the complete set of MPS students in their grade with baseline WKCE test scores within five percent of their score. This was done within 20 bands from the lowest to the highest based on the distribution of independent charter student combined reading and math test scores. As an example, the first band consisted

2 We are particularly grateful to Deb Lindsey of MPS, Robert Kattman of UW-M, and Cindy Zautcke of the Common Council for their support and assistance in obtaining the necessary data. All student data were provided to us absent personal information about the student, such as name and address, or such "personal signifiers" were deleted from the data prior to analysis.

3 See Witte *et al*., 2010a for figures and tables describing the results of our matching protocol.

of students who scored in the 1st-5th percentiles, the second band consisted of students in the 6th-10th percentile, etc. Second, the charter panelist and each MPS student within that five percent test score band were assigned a propensity score that predicted their likelihood of being in a charter school based on race, gender, English Language Learner (ELL) status, and participation in the federal Free/Reduced Price Lunch (FRL) program. The MPS student within the grade band with the charter school propensity score closest to the propensity score of a given student in the charter panel was drawn out of the panel (without replacement) and became a member of the MPS comparison sample. The result of all these matches was a sample of 2,295 independent charter school students and 2,295 MPS comparison students that closely resemble the charter school students on baseline test scores and other factors that predict charter school enrollment. The purpose of this procedure was to reduce the differences in observed characteristics that existed between the independent charter students and a random sample of MPS students.

When comparing the Independent Charter and MPS Matched samples, the only statistically significant differences in baseline test scores occur in 4th grade math and 6th grade math. Both of those differences between the charter and matched samples are statistically significant only at the 90 percent confidence level, the lowest confidence level that we use in this evaluation. This suggests the matching was successful. Thus, in terms of prior achievement we have created matched samples that are essentially equivalent at baseline.

Our matching algorithm also produced charter and MPS student samples that are generally similar regarding other important measurable student characteristics (see Appendix C and Table C2 for details). The two samples are very close on race and gender demographics. The MPS Matched sample does differ significantly from the Independent Charter Sample regarding populations of exceptional education[4] and free lunch students, though a random sample of MPS students would have differed from the charter sample even more regarding these two student characteristics (See Witte *et al.,* 2010). Because of these differences, in most of the analyses to follow, we independently control for all of these student characteristics in our most precise regression models.[5]

The matching design and baseline control variables limit the extent to which measurable student characteristics might bias our analysis of independent charter and MPS student test score gains. Because students were not randomly assigned to the two groups, however, we cannot rule out unmeasured student characteristics as a potential source of bias. For example, if the students in Milwaukee independent charter schools are similar to our matched MPS sample in most ways except that they have more motivated parents, as demonstrated by the

4 We ran a sensitivity analysis predicting the likelihood of a student having an exceptional education status. The fixed effects regression results showed that the charter coefficient was not significant meaning that students in both sectors had an equal likelihood of having a disability.

5 The initial difference between the charter and matched sample on free lunch status is due to incomplete free lunch data counts in a few schools. We correct for this in our models in two ways. If a student had a free lunch observation in 2007-08, 2008-09, 2009-10 or 2010-11, we back-filled the data. In addition, for students with missing data on free-lunch or any other control variable, we include an indicator in our models controlling for this missing data. Doing so allows our regression models to draw upon the actual data in each student observation, and only that actual data, to inform the coefficient estimates of the model (Cohen & Cohen, 1983).

fact that they enrolled the student in a school of choice, then the charter students might demonstrate stronger achievement gains simply due to such a "self-selection" bias. On the other hand, if parents seek alternatives to their neighborhood public school primarily when their child is struggling or exhibiting behavior problems, the match on baseline achievement might not fully capture the inherent educational disadvantages of charter school students, thereby biasing our analysis against better performance from charter schools.

We think that the fact that our study is situated in Milwaukee helps to reduce the threat of positive or negative unmeasured selection biases. As discussed above, many school choice options are available to parents even within the Milwaukee Public School (MPS) system. Highly motivated parents, or parents of students who are struggling in their neighborhood public school, can and likely do seek out alternative placements for their child within MPS. These options include vouchers to attend private schools, magnet schools, MPS charter schools, and open enrollment into other school districts. Since school choosers are present in both our charter and MPS matched comparison samples, concerns about self-selection bias when comparing student achievement gains across sectors are, to some extent, mitigated.

Main Effects and Supplemental Analyses

The primary goal of this report is to estimate the effect of independent charter school attendance on student achievement gains. However, a secondary goal of the report is to understand the specific mechanisms through which any effects might operate. Over the five years of this study, students in the MPS and independent charter samples likely experienced a number of changes in family and school context, and some of these changes are likely to affect student achievement. An example we explore in the appendix is school switching. In this study, and many other studies, school switching has a negative effect on student achievement (e.g. Hanushek, Kain & Rivkin, 2004; Cowen *et al.,* 2010). If there are differences in the rate of switching schools for charter school and MPS students, that may contribute to an explanation of the main effect which is the basic comparison on achievement growth between the two samples. Thus in what follows we present *main effects* based on all students in the samples, and then provide a set of *supplemental analyses* which refine and help us understand important variations in and possible explanations for our main effects.

For the main effects in this report students are assigned to their sector (charter or MPS) based on where they were enrolled in 2006. If they cross over to another sector and we can locate a test score for them, we use that score and keep them in the study still assigning them to their initial sector. This is standard practice in randomized clinical trials. In some of the supplemental analyses we relax this condition.

MAIN EFFECTS ON STUDENT ACHIEVEMENT GAINS: 2006-07 to 2010-11

We employ both descriptive statistics and multivariate regression methods to compare four-year achievement gains of students in independent charter schools and comparable, matched students in Milwaukee Public Schools. Prior to any analysis, we first standardized the WKCE scale scores into z-scores using the MPS district means and standard deviations for math and reading.[6] For all MPS students this procedure would produce an average z-score of 0 with a standard deviation of 1.0. Our samples deviate from these norms at baseline in that the average standardized student score is below 0, a fact which further confirms that the students in both the independent charter sample and MPS matched sample are educationally disadvantaged relative to the average MPS student. These normalized z-scores are used throughout the analysis.

Average Math and Reading Achievement Growth

We compared mean growth in standardized scores for independent charter and MPS students across grades and subjects. One-, two-, three-, and four-year change in math and reading achievement for students in grades 7, 8 and 10 for the sample of students remaining in 2010 are presented in Tables 3 and 4 for our charter and MPS samples.[7] These results are broken out by grade level to examine the variation in student learning gains by sector across the different grades. The change calculations are created by using the student's grade in 2010, where, for example, students in grade 3 at baseline are in grade 7 in 2010. Using a student's grade in 2010, we estimate the mean *change score* for charter and MPS students in that grade. Since 2010 is the outcome year, a one-year change is defined as subtracting the 2009 score from the 2010 score. Similarly, a two-year change is computed by taking the difference of the 2010 score and the 2008 score, etc. After finding the average change score for each sector, we take the difference between the two averages to determine whether growth favors charter or MPS students.

The grade-specific results, which are presented in Table 3 for math and Table 4 for reading, are generally a mix of non-significant and positive results favoring charter schools. The clearest charter advantages are for students in grade 7, with these charter students making significantly greater growth in math and reading in all but the first year. Likewise, charter school students in grade 8 exhibit greater three- and four-year growth in reading (Table 4). Across all grades, there are charter advantages in both reading and math. Charter school students make greater two- and four-year growth in math, as well as greater two-, three- and four- year growth in reading. The remaining results are non-significant, meaning that the performance of charter school students does not statistically differ from that of similar students in MPS.

6 We computed normalized z-scores by grade level in all four years for reading and math. For example, the formula for ZMath2007 in Grade 3 was ((Grade 3 ScaleMath2007– Grade 3 MPS district mean scale score)/(Grade 3 MPS district standard deviation)).

7 The number of grades and the sample sizes are considerably reduced from our baseline sample because students "aged out" of the sample, advancing to grades for which there were no test scores. The sample in this report thus consists of students originally in grades 3, 4 and 6 in 2006 for whom we could locate a test score in 2010.

There are exceptions to the general trend outlined above. Specifically, charter school students in grade 10 make less two-year growth in reading, and three-year growth in both reading and math. Eighth grade charter school students exhibit lower one-year growth in math compared to MPS students. This estimate, however, only reaches the lowest level of statistical significance. Comparing all grades together, there are no statistically significant differences in math, but there are three- and four-year advantages for charter school students in reading.

Table 3. Mean Math Achievement by Grade in Outcome Year, 2006-07 to 2010-11

Grade 2010	Group	One-Year Change (09-10)		Two-Year Change (08-10)		Three-Year Change (07-10)		Four-Year Change (06-10)	
		Mean Growth	s.e.(diff)	Mean Growth	s.e.(diff)	Mean Growth	s.e.(diff)	Mean Growth	s.e.(diff)
7	Charter	.085		.264		.258		.372	
	MPS Matched	.026		.071		.006		.165	
	(Difference)	**(.059)**	**(.059)**	**(.193)*****	**(.069)**	**(.252)*****	**(.075)**	**(.207)*****	**(.077)**
	Sample Size	**[N=492]**		**[N=486]**		**[N=487]**		**[N=518]**	
8	Charter	-.048		-.010		.092		.363	
	MPS Matched	.058		.069		.145		.286	
	(Difference)	**(-.106)***	**(.055)**	**(-.079)**	**(.059)**	**(-.053)**	**(.067)**	**(.077)**	**(.073)**
	Sample Size	**[N=528]**		**[N=529]**		**[N=531]**		**[N=569]**	
10	Charter			-.088		-.152		-.178	
	MPS Matched			-.081		.032		-.042	
	(Difference)			**(-.007)**	**(.079)**	**(-.184)****	**(.075)**	**(-.136)**	**(.088)**
	Sample Size			**[N=294]**		**[N=373]**		**[N=422]**	
All Grades	Charter	.019		.074		.081		.201	
	MPS Matched	.043		.019		.062		.128	
	(Difference)	**(-.024)**	**(.040)**	**(.054)**	**(.039)**	**(.020)**	**(.042)**	**(.072)**	**(.047)**
	Sample Size	**[N=1020]**		**[N=1309]**		**[N=1391]**		**[N=1509]**	

***p<0.01, **p<0.05, *p<0.10

Note: The table presents one-, two-, three- and four-year change for students in grades 7, 8, and 10 in 2010. Two sample t-tests were run to test the significance of differences in average growth between our MPS Matched sample and Charter sample. Mean growth scores for each sector are rounded to the third significant digit. Response weights were included in the estimation of differences in means.

Table 4. Mean Reading Achievement by Grade in Outcome Year, 2006-07 to 2010-11

Grade 2010	Group	One-Year Change (09-10)		Two-Year Change (08-10)		Three-Year Change (07-10)		Four-Year Change (06-10)	
		Mean Growth	s.e.(diff)	Mean Growth	s.e.(diff)	Mean Growth	s.e.(diff)	Mean Growth	s.e.(diff)
7	Charter	.032		.259		.246		.311	
	MPS Matched	.005		.072		.030		.131	
	(Difference)	**(.027)**	**(.058)**	**(.187)*** **	**(.071)**	**(.216)*** **	**(.080)**	**(.180)** **	**(.090)**
	Sample Size	**[N=492]**		**[N=486]**		**[N=487]**		**[N=518]**	
8	Charter	.006		.088		.263		.302	
	MPS Matched	.009		.044		.103		.160	
	(Difference)	**(-.003)**	**(.054)**	**(.044)**	**(.058)**	**(.160)*** **	**(.062)**	**(.142)** **	**(.069)**
	Sample Size	**[N=529]**		**[N=531]**		**[N=530]**		**[N=571]**	
10	Charter			-.145		-.145		-.064	
	MPS Matched			.010		.007		-.007	
	(Difference)			**(-.155)** **	**(.078)**	**(-.152)** **	**(.074)**	**(-.057)**	**(.080)**
	Sample Size			**[N=294]**		**[N=373]**		**[N=423]**	
All Grades	Charter	.019		.094		.137		.191	
	MPS Matched	.007		.042		.046		.089	
	(Difference)	**(.012)**	**(.040)**	**(.053)**	**(.040)**	**(.091)** **	**(.042)**	**(.101)** **	**(.046)**
	Sample Size	**[N=1021]**		**[N=1311]**		**[N=1390]**		**[N=1512]**	

***p<0.01, **p<0.05, *p<0.10

Note: The table presents one-, two-, three- and four-year change for students in grades 7, 8, and 10 in 2010. Two sample t-tests were run to test the significance of differences in average growth between our MPS Matched sample and Charter sample. Mean growth scores for each sector are rounded to the third significant digit. Response weights were included in the estimation of differences in means.

The Distribution of Math and Reading Growth

It is equally important to understand the distribution of growth as it is to note averages. The density, which approximates the number of individuals at specific points in the achievement distribution, is provided in kernel diagrams in Figures 1 and 2. Examining the kernel density distributions of both sectors in reading and math will help us to understand the shape of the growth in our samples. For both reading and math, the distributions are mostly overlapping and are normally distributed. Non-overlapping distributions would indicate variation in performance between the two sectors. For math, the MPS matched sample has somewhat more students just below the mean of the distribution, while the reverse is true for charter students just above the mean. In reading (Figure 2) the peak of the charter distribution is to the right of the MPS distribution demonstrating an advantage for charter students. The range of students scoring at the high end and low end is very similar in both sectors.

Figure 1.
Math Growth (Z-Scores)
for All Students in Grades 7, 8, and 10: 2006 to 2010

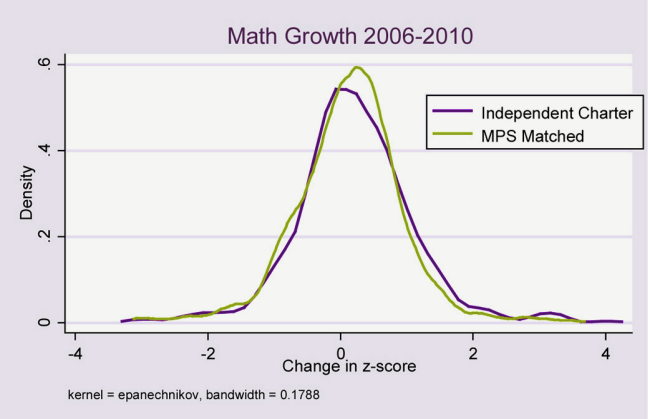
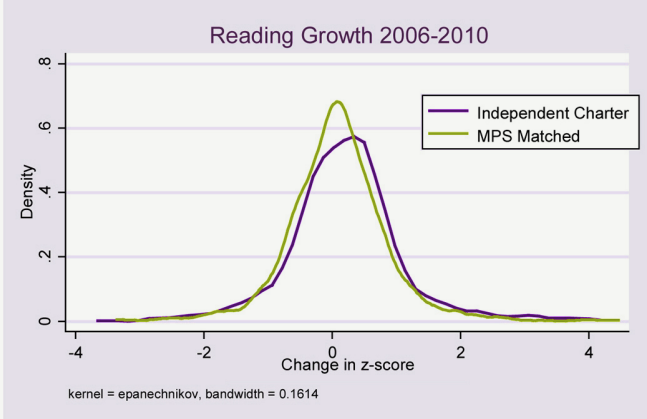


Figure 2.
Reading Growth (Z-Scores)
for All Students in Grades 7, 8, and 10: 2006 to 2010



Models for Math and Reading Achievement Gains

Using the dataset described above, we estimate the impact of independent charter school attendance on gains in math and reading controlling for student characteristics. Our analytic sample used to estimate the effect of independent charter school attendance on four-year achievement gains consists of 1,559 students. To control for potential achievement differences by grade, we include grade indicator variables in all equations. We control for baseline achievement by including the student's baseline (2006) test scores in both subjects. The basic model for estimating four-year gains is represented by the following equation:

$$\text{(eq 1)} \qquad Y_{2010,i} = \beta_0 + \beta_1 C_i + \beta_2 Y_{2006m,i} + \beta_3 Y_{2006r,i} + \beta_4 G_i + \beta_5 X_i + \varepsilon_i$$

In this equation, for each student *i*, β_1 represents the effect of student enrollment in a charter school in 2006-07 (C=1) and β_2 and β_3 estimate the impact of baseline math and reading achievement. With this specification, the contribution of the baseline test to the estimate of the 2010 test score is unconstrained in that β_2 and β_3 can take any value.[8] β_4 represents a vector of grade-specific contributions to the intercept and β_5 represents the impact of a set of student-level characteristics, X_i, such as gender and race/ethnicity.

The outcomes of interest are 2010-11 reading and math scores on the WKCE which are standardized for students in grades 7, 8 and 10 in 2010. Student characteristics included are those typically found in studies of charter school performance and include free and reduced lunch status, exceptional education status (ExEd),

8 Some researchers have used differences in test scores as the dependent variable by subtracting the baseline test score from the outcome year test score. However, if we want to model achievement growth controlling for prior achievement, this has the effect of constraining the effect of prior achievement to 1.0, which empirically is not the true parameter. Thus, we favor the estimation model in Equation 1.

race, and gender.[9] English language learner (ELL) status was not included because there were very few students formally classified as ELL in the charter schools. The race indicator variable is coded as 1 for black students and 0 for non-black students, which serves as the reference group. We collapse racial groups other than black students into the non-black students category because there are substantially fewer whites, Hispanics, Asians, and Native Americans in the sample.[10] To correct for potential asymmetric attrition from the charter and MPS samples, we use non-response weights that were constructed using observable baseline student characteristics. The weighted results reported below are substantively similar to the results from estimating the same models on unweighted samples. The estimations also account for the clustering of students within schools by employing robust and clustered standard errors.

Results for Regression Models of Charter Impacts on Four-Year Math and Reading Achievement Growth

Main effects of independent charter school status on four years of growth are presented in Table 5 in Models 1 through 3. Model 1 controls only for charter status and shows the effect of charter attendance at baseline on student achievement in 2010. In 2010, students in independent charter schools score higher on average than MPS students in both reading and math, but the results are not statistically significant. This model does not tell us how much charter school students have gained because it does not control for prior achievement at baseline.[11] Model 2 controls for baseline (2006) achievement in both reading and math. The coefficients slightly increase for students attending charter schools, but the results are also not statistically significant.

Of the models presented, Model 3 is our best model of student achievement gains because in this model we control for prior achievement and any differences in student characteristics. Our discussions of main effects and the supplementary analyses below will focus primarily on that specific model. As with Models 1 and 2, the effect of charter school enrollment on reading and math scores from Model 3 is positive but not statistically significant.

9 We acknowledge that participation in the federal free and reduced lunch (FRL) program can be an inconsistent measure of student poverty across grades and sectors, since older students are more likely to decline participation even if eligible and some schools outside of the traditional public school system choose not to participate in the program at all. Such problems are especially acute when comparisons are being made between the public and private school sectors (Peterson & Llaudet, 2006). In spite of these concerns, we use the FRL indicator in our models for three reasons. First, our comparison is between different types of public schools—independent public charters compared to schools within a traditional public school system. Second, all of the schools represented in our sample do participate in the FRL program. Third, participation in the FRL program is the only proxy measure of student poverty available to us. Leaving the federal lunch program out of our models would have invited omitted variable bias of an unknown direction and magnitude to undermine our analysis.

10 In 2010-11, there are 2,880 non-missing black students and 98 non-missing non-black students.

11 If this were a randomized field trial, or if the initial matching on prior tests was perfect, Model 1 would also accurately estimate growth. However, because of the differences between samples in prior achievement in some grades (Table C1) and in student characteristics (Table C2), more complex models will improve the accuracy of estimated effects.

Table 5. Four- Year Growth Models of Math and Reading Achievement for Average Charter Impacts, 2006-2010

	Model 1- Charter Status		Model 2- Controlling for Prior Test Scores Only		Model 3- Student Characteristics Included	
	Math 2010	Reading 2010	Math 2010	Reading 2010	Math 2010	Reading 2010
Charter 2006	.107 (.142)	.047 (.148)	.111 (.067)	.069 (.083)	.058 (.052)	.053 (.066)
2006 Score – Reading			.223*** (.029)	.466*** (.034)	.193*** (.026)	.411*** (.026)
2006 Score- Math			.432*** (.027)	.213*** (.025)	.445*** (.030)	.224*** (.026)
Grade 7					-.239** (.108)	-.275*** (.088)
Grade 8					-.215 (.134)	-.234** (.089)
Grade 10					-.479*** (.137)	-.456*** (.105)
Black					-.288*** (.079)	-.399*** (.080)
Female					-.067 (.068)	.083 (.057)
ExEd					-.218** (.085)	-.370*** (.075)
Free Lunch					-.076 (.056)	-.097* (.057)
Constant	-.131*** (.045)	-.049 (.047)	.017 (.030)	.070** (.028)	.748*** (.134)	.833*** (.109)
N	1556	1559	1556	1559	1556	1559
R^2	.003	.001	.427	.449	.462	.487
F	0.58	0.10	362.26	318.54	.	.

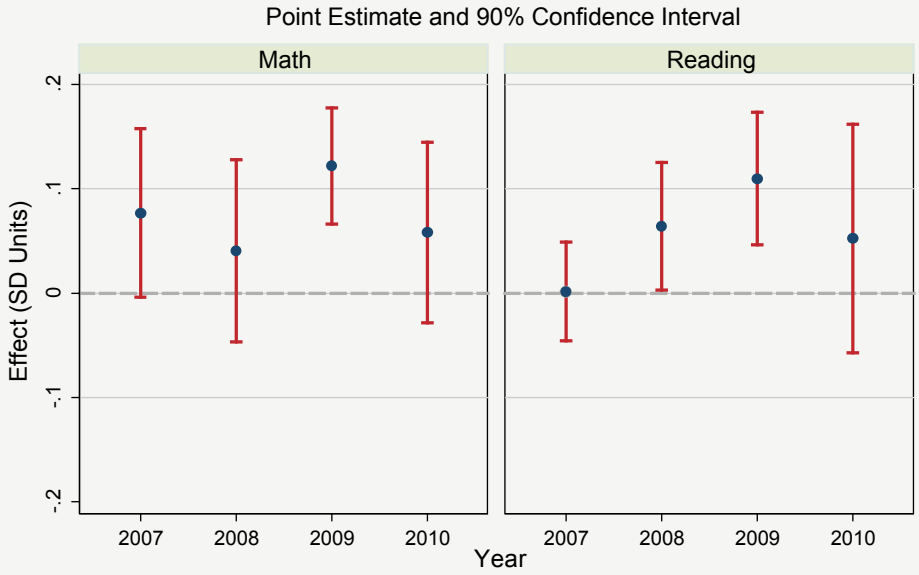
***p<0.01, **p<0.05, *p<0.10

Tabled results control for race, gender, grade, free lunch, exceptional education in Model 3. Reference categories for these variables are non-black, male, grade 6 in 2010, no free lunch, and no exceptional education. Two prior test scores are also controlled for in Models 2 and 3. Robust standard errors are estimated to account for the clustering of students within particular schools. F-tests cannot be computed using robust standard errors when a cell in the regression matrix is only a single student.

In all models estimating achievement gains, charter school students perform similarly to MPS students statistically in both reading and math (Table 5). Control variables in Model 3 of Table 5 perform as expected, giving us confidence in the reliability of our analysis. Consistent with prior research, students in both MPS and the independent charter sectors with higher baseline achievement (2006 test scores) have higher achievement four years later, relative to students with lower prior achievement. In contrast, black students in both sectors show lower four-year achievement gains than non-black students in most models. Similarly, students who receive exceptional education services exhibit lower achievement gains compared to non-disabled students.

Figure 3 puts these results in historical context by providing a graphical depiction of the effect of independent charter attendance on yearly achievement gains in both math and reading. The early year results are based on Model 3 estimates from prior years as reported earlier (Witte, *et* al., 2010; Witte, *et* al, 2011). The dots represent the coefficient values in Model 3, and the bars represent the confidence intervals around those estimates. If the bars *do not* cross the zero line, we can reject the null hypothesis that there is no difference between independent charter and MPS achievement growth for the relevant year. As is apparent, all the mean estimates favor independent charters, but only the second and third years of growth in reading and the third year of growth in math allow us to say with at least 90% certainty that the independent charter advantages are greater than zero. Readers should note that the confidence intervals around the 2010 growth effect estimates are much wider than the intervals around the 2009 estimates. The main reason for this difference is the fact that a large cohort of students in the study, those who were in 7th grade in 2006, contributed test scores to the 2009 growth analysis but had "aged out" of the study sample for purposes of the 2010 analysis. All else equal, confidence intervals grow as sample sizes shrink.

Figure 3. Effect of Independent Charter Attendance on Student Achievement, by Year



SUPPLEMENTAL ANALYSES OF STUDENT ACHIEVEMENT GAINS

As stated in the introduction, this report is divided into main effects and supplemental analyses that help explain and understand the primary results. In this section we address three factors that add to our understanding of the variance in the primary effects. They are the type of independent charter school, charter school effects across the achievement distribution, and the effects for a subgroup of each sample – those who stayed in either charter schools or MPS schools for the full five years. A final analysis of students who switch schools is included in Appendix B.

Variation in Main Effects by Type of Charter Schools

In addition to understanding the main effect of attending an independent charter or a MPS school, we are also interested in the effects of two different types of charter schools. Four of the independent charter schools were initially private schools that changed school sectors by converting to independent charters (i.e. conversion charters). The other 6 charters were startup schools (i.e. non-conversion charters).[12] There were only 204 students from our original baseline sample in 2010-11 enrolled in conversion charter schools, compared to 463 students in the non-conversion charter schools. We capture and test for the differential effects of these two types of charter schools in the estimation of equation 2.

$$\text{(eq 2)} \qquad Y_{2010,i} = \beta_0 + \beta_1 CC_i + \beta_2 NCC_i + \beta_3 Y_{2006m,i} + \beta_4 Y_{2006r,i} + \beta_5 G_i + \beta_6 X_i + \varepsilon_i$$

In this specification we split the charter indicator variable in equation 1 into conversion charters (CC) and non-conversion charters (NCC), with the effects of these indicators captured by estimating the β_1 and β_2 parameters. The remaining variables are defined as those contained in equation 1.

While the main effects analysis showed similar performance of students in charter and MPS schools, results presented here by charter school type reveal a more nuanced picture. These results are depicted in Table 6. Conversion charter school students make significantly greater four-year achievement gains than MPS students in reading. Controlling for baseline test scores and student characteristics (Table 6, Model 3), conversion charter attendance is estimated to increase four-year reading achievement gains by .193 standard deviations. This effect is highly statistically significant at the 99 percent level of confidence. However, in math, the conversion charter advantage in Model 2 becomes non-significant in Model 3 once accounting for student background characteristics. Students in non-conversion charter schools, in contrast to those in conversion charter schools, perform no differently than MPS students across all models for both subjects.

12 In most states, schools are called "conversion charters" if they are former traditional public schools that converted to charter school status. We use the term here to refer to former private schools because a substantial number of private schools (4) have converted to public charter status in Milwaukee. Most of the conversion charters in this study were formerly in the Milwaukee Parental Choice (voucher) Program. Schools may have switched status because they received greater compensation per student as charter schools, and, unlike in the voucher program, student eligibility in charters is not limited to low-income families.

Table 6. Four- Year Growth Models of Math and Reading Achievement for Conversion and Non-Conversion Charter Impacts, 2006-2010

	Model 1- Conversion and Non-Conversion Charter Status		Model 2- Controlling for Prior Test Scores Only		Model 3- Student Characteristics Included	
	Math 2010	Reading 2010	Math 2010	Reading 2010	Math 2010	Reading 2010
Conversion Charter 2006	.468*** (.161)	.496*** (.164)	.213** (.086)	.253*** (.096)	.113 (.070)	.193*** (.069)
Non-Conversion Charter 2006	-.045 (.152)	-.143 (.153)	.068 (.083)	-.010 (.104)	.033 (.068)	-.011 (.087)
2006 Score - Reading			.218*** (.028)	.456*** (.031)	.191*** (.027)	.407*** (.026)
2006 Score - Math			.428*** (.029)	.205*** (.027)	.443*** (.031)	.217*** (.026)
Grade 7					-.241** (.109)	-.283*** (.089)
Grade 8					-.213 (.135)	-.229** (.090)
Grade 10					-.478*** (.137)	-.454*** (.106)
Black					-.265*** (.076)	-.343*** (.072)
Female					-.070 (.068)	.073 (.055)
ExEd					-.224** (.089)	-.387*** (.070)
Free Lunch					-.062 (.055)	-.062 (.055)
Constant	-.131*** (.045)	-.049 (.048)	.015 (.030)	.067** (.028)	.718*** (.133)	.758*** (.097)
N	1556	1559	1556	1559	1556	1559
R^2	.033	.046	.429	.456	.463	.491
F	4.37	5.32	269.03	229.50	.	.

***p<0.01, **p<0.05, *p<0.10

Tabled results control for race, gender, grade, free lunch, exceptional education in Model 3. Reference categories for these variables are non-black, male, grade 6 in 2010, no free lunch, and no exceptional education. Two prior test scores are also controlled for in Models 2 and 3. Robust standard errors are estimated to account for the clustering of students within particular schools. F-tests cannot be computed using robust standard errors when a cell in the regression matrix is only a single student.

The historical plots of results for conversion and non-conversion charter schools for each year of the evaluation are displayed in Figures 4 and 5. Conversion charters show a consistent, upward trend in reading achievement gains over time. By contrast, trends over time for conversion charter schools in math and non-conversion charter schools in both subjects are more mixed, showing fluctuations in achievement gains.

Figure 4. Effect of Conversion Charter Attendance on Student Achievement, by Year

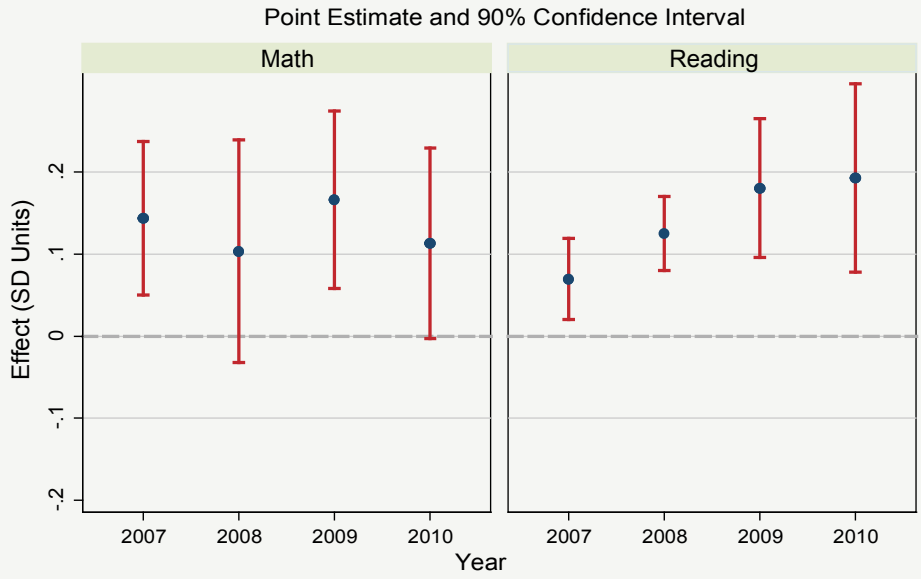
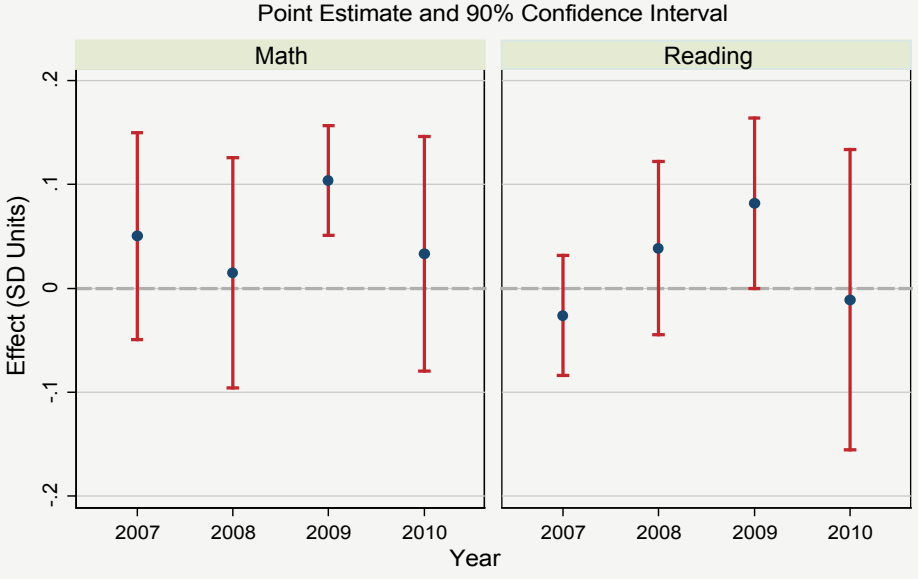


Figure 5. Effect of Non-Conversion Charter Attendance on Student Achievement, by Year



Variation in Main Effects by Student Achievement Levels

A second supplemental analysis examines potential variation in charter school impacts based on the level of achievement of students in 2010. We do this using quantile regressions, which estimate the effects of being in charter schools for students at different levels of achievement. We examine charter impacts at the 10th, 25th, 50th, 75th and 90th percentiles of the 2010 outcome achievement distributions. All of the controls included in Model 3 in Tables 5 and 6 are included in the quantile regressions. The results for quantile regressions in reading and math are presented in Table 7.

Table 7. Results of Quantile Regressions Estimating Charter Impacts on Four-Year Achievement Gains

	.10	.25	Median	.75	.90
	Math (N=1556)				
Charter main effect	.131(.089)	.063(.053)	.018(.045)	.039(.041)	.048(.047)
Conversion charter	.171(.166)	.071(.079)	.114(.053)**	.044(.068)	.090(.079)
Non-conversion charter	.105(.107)	.059(.057)	.004(.040)	-.025(.052)	-.020(.058)
	Reading (N=1559)				
Charter main effect	-.008(.092)	.041(.048)	.086(.028)***	.122(.041)***	.026(.055)
Conversion charter	.229(.145)	.243(.071)***	.149(.051)***	.162(.058)***	.083(.076)
Non-conversion charter	-.113(.099)	-.013(.052)	.060(.039)	.080(.046)*	.014(.065)

***p<0.01, **p<0.05, *p<0.10

Note: Test scores measured as standardized scores. Tabled results control for race, free lunch status, exceptional education, grade, and prior achievement. The point estimates for these controls are not included in the table but are available upon request.

Quantile results show that there are few significant effects of independent charter schools on average and these effects are confined to reading. Independent charters deliver comparatively higher rates of gain for students in reading at the median and at the 75th percentile of that distribution. The absence of significant charter effects in math suggests that independent charter schools perform the same as MPS schools at all points of the achievement distribution in math.

When results are split by the type of charter school, conversion charter schools are more effective for students at the median in math and at the 25th, 50th and 75th percentiles of the distribution in reading. The conversion charter effects in reading are highly statistically significant at the 99 percent confidence level. Conversion charter schools appear to do the most for students at the 25th percentile in reading who make about .24 standard deviations more gains than students in MPS.

Variation in Main Effects for Students Who Stay in the Same Sector for Five Years

The main effects for this study used all students in charter schools and an equal number of matched MPS students based on their initial sector attendance in 2006. However, students switch schools and sectors, and some are lost to the study. These are ongoing problems for longitudinal observation and random assignment studies. A key issue is the attribution of treatment effects. For example, if a student is initially in a charter school, but then spends the next three years in an MPS school, how do you attribute their learning gains? There is no single answer. We could allow the initial condition to determine sector, as we have in the main analysis and as is done in randomized field trials, or we could weight the relative exposure to charters or MPS (a dosage effect).

Another method is to estimate the results only for those students who remain in the same sector for the duration of the study. Following this approach, we estimated results for a subgroup of "stayers". Stayers are students who remain in the same sector, independent charter or MPS, for the five years of the study. These estimates are a sensitivity analysis to control for attrition and those who crossover between sectors.

The results for the stayers' analysis are presented in Tables 8 and 9. Amongst stayers, there are large and substantial positive effects for students who remain in independent charter schools between 2006-07 and 2010-11. Four-year achievement gains of stayers in independent charter schools are on the order of .411 standard deviations in math and .335 standard deviations in reading (Table 8). These effects reach the 99 percent level of confidence. Considering that the students in charter schools performed similarly to MPS students in the full sample, the effects of charter schools on stayers are very large.

Table 8. Non-Sector Switching (Stayer) Four-Year Growth Models of Math and Reading Achievement for Independent Charters on Average, 2006-2010

	Model 1- Charter Status		Model 2- Controlling for Prior Test Scores Only		Model 3- Student Characteristics Included	
	Math 2010	Reading 2010	Math 2010	Reading 2010	Math 2010	Reading 2010
Charter 2006	.573*** (.122)	.467*** (.126)	.458*** (.063)	.357*** (.074)	.411*** (.074)	.335*** (.071)
2006 Score - Reading			.214*** (.033)	.494*** (.038)	.170*** (.033)	.428*** (.037)
2006 Score - Math			.426*** (.040)	.181*** (.033)	.428*** (.041)	.188*** (.033)
Grade 7					-.162 (.101)	-.228** (.087)
Grade 8					-.102 (.117)	-.127 (.087)
Grade 10					-.199 (.123)	-.224** (.093)
Black					-.171** (.072)	-.309*** (.069)
Female					-.021 (.050)	.103** (.047)
ExEd					-.296*** (.091)	-.386*** (.092)
Free Lunch					-.105 (.064)	-.106* (.061)
Constant	-.103** (.046)	-.024 (.051)	.018 (.032)	.072** (.030)	.466*** (.115)	.605*** (.107)
N	1068	1068	1068	1068	1068	1068
R^2	.082	.052	.487	.505	.509	.534
F	22.08	13.85	157.55	175.93	.	.

***p<0.01, **p<0.05, *p<0.10

Tabled results control for race, gender, grade, free lunch, exceptional education in Model 3. Reference categories for these variables are non-black, male, grade 6 in 2010, no free lunch, and no exceptional education. Two prior test scores are also controlled for in Models 2 and 3. Robust standard errors are estimated to account for the clustering of students within particular schools. F statistics could not be computed for Model 3 because a regressor in one of the clusters contained only one nonzero value. F-tests cannot be computed using robust standard errors when a cell in the regression matrix is only a single student.

Table 9. Non-Sector Switching (Stayer) Four-Year Growth Models of Math and Reading Achievement for Conversion and Non-Conversion Charter Impacts, 2006-2010

	Model 1- Charter Status		Model 2- Controlling for Prior Test Scores Only		Model 3- Student Characteristics Included	
	Math 2010	Reading 2010	Math 2010	Reading 2010	Math 2010	Reading 2010
Conversion Charter 2006	.692*** (.163)	.679*** (.131)	.440*** (.067)	.422*** (.066)	.362*** (.111)	.368*** (.050)
Non- Conversion Charter 2006	.455*** (.140)	.258 (.155)	.475*** (.095)	.295** (.129)	.458*** (.081)	.302** (.125)
2006 Score - Reading			.214*** (.033)	.491*** (.037)	.171*** (.033)	.427*** (.037)
2006 Score - Math			.426*** (.040)	.179*** (.033)	.429*** (.041)	.187*** (.033)
Grade 7					-.158 (.098)	-.231** (.088)
Grade 8					-.101 (.114)	-.128 (.087)
Grade 10					-.194 (.120)	-.228** (.094)
Black					-.197** (.085)	-.291*** (.061)
Female					-.016 (.048)	.100** (.047)
ExEd					-.292*** (.092)	-.389*** (.092)
Free Lunch					-.117** (.059)	-.097 (.060)
Constant	-.103** (.047)	-.024 (.051)	.019 (.032)	.071** (.030)	.494*** (.124)	.586*** (.096)
N	1068	1068	1068	1068	1068	1068
R^2	.087	.069	.487	.506	.509	.534
F	13.11	14.02	134.85	123.86	.	.

***p<0.01, **p<0.05, *p<0.10

Tabled results control for race, gender, grade, free lunch, exceptional education in Model 3. Reference categories for these variables are non-black, male, grade 6 in 2010, no free lunch, and no exceptional education. Two prior test scores are also controlled for in Models 2 and 3. Robust standard errors are estimated to account for the clustering of students within particular schools. F-tests cannot be computed using robust standard errors when a cell in the regression matrix is only a single student.

When the effects for stayers are estimated by charter school type, positive results are found for students in both conversion and non-conversion charter schools. The effects for students in conversion charter schools are considerably larger than for non-conversion charter students in the full sample in both math and reading. In math for the full sample, the charter advantage was .11 and not statistically significant (Table 6, Model 3). The charter advantage increases to .362 and is significant at the .01 level when we estimate the effect of conversion charters on stayers. Reading results are almost double those in the full sample with the point estimate .368 standard deviations greater than MPS student stayers. A similar, but even more pronounced trend occurs for students in non-conversion charter schools if they remain in their sector for five years. Results for these students in the full sample (Table 6, Model 3) show no differences between students in non-conversion charters and the MPS matched sample. However, for non-conversion stayer students the four-year math achievement gains are on the order of .458 standard deviations greater than for stayer students in MPS (Table 9, Model 3). The differences in reading go from -.01 (Table 6) to +.302 (Table 9), with the former being essentially zero and the latter significant with 99 percent confidence.

CAVEATS

In most studies of schools located in poor urban contexts, typically there are missing data due to sample attrition. Issues of sample attrition are explored in substantial detail in Appendix A, but we note here that about 34 percent of panelists are missing in 2010, with 11.3 percent of MPS sample members missing and 22.7 percent of independent charter sample members missing.[13] Although these numbers are much lower than expected, and lower than in a number of other studies, they could raise concerns that the attrition was non-random. In theory, this could affect accurate overall population estimates of gains, but because there were few baseline test differences between missing students from either sample, we believe our sample comparisons are accurate (See Appendix A). Nevertheless, we weighted the analytic sample to re-balance the sample to reflect the equivalence of our matched samples at baseline. Thus we feel confident that attrition has been adequately addressed.

The strong results favoring conversion charter schools and students who remain in the same sector for five years raise selection issues. If conversion charter schools entered the study with students more readily able to gain in achievement, they would have an advantage over the other charter schools or the MPS sample. We must assume that many of the students in 2006 were in these schools before they converted to charter schools, and private schools often can more easily select out students. However, an equally plausible alternative is that these may be more experienced and effective schools. After all, the conversion charter schools in our sample had operated as private schools in the past, meaning they did not have to face the initial learning curve that startup charters

13 Missing means that we cannot locate a student in any database we use (enrollment, testing, etc.). Those students who "age out" of testing, but can still be accounted for, are not counted as attriting from the study.

need to negotiate. Similarly, if charter school stayers are differentially selected—either by school or by family choices—than their counterpart stayers in MPS, the results would also be biased in favor of charters through that selection. However, the alternative is that charter schools may simply have an increasingly more positive effect on students the longer they stay in the charter school.

SUMMARY AND CONCLUSIONS

This is the final report about the performance of independent charter students in Milwaukee compared to a matched sample of students in the Milwaukee Public Schools. The results of this and previous analyses of achievement gains generally support the existence of at least some positive independent charter school effects over time in Milwaukee.

The results of the comparisons on math and reading scores differ by years and by the statistics employed. We reported last year that there was

> …a clear pattern of positive charter school effects growing over time. There was little consistent evidence of differences in achievement gains between charter and MPS students after one year. The second year growth was better for charters in some models and for some tests, but not for others. In the third year of growth, a sizable independent charter school advantage was apparent in all of our analyses (Witte *et al.*, 2011).

That trend was not continued in the fifth year where estimates of four-year achievement growth are positive for charter schools but the basic models do not produce statistically significant differences between students attending all independent charters and the MPS sample of students. On the other hand, students in conversion charter schools, which were once private schools, consistently outperformed similar MPS students in our matched sample in every year. In one model, the larger growth in math after five years is positive but not quite statistically significant.

One of our supplementary analyses determined that students who remained in charter schools over five years (e.g. "stayers") made significant achievement gains in both reading and math compared to their counterpart stayers in MPS. This finding holds for charter schools on average, as well as conversion and non-conversion charter schools. These results are between three- and four- tenths of a standard deviations and significant at the 99 percent confidence level. In sum, our study results suggest that a given Milwaukee student stands a reasonable chance of achieving higher test scores if the student enrolls in an independent public charter school as opposed to an MPS school, especially if the test is in reading, the charter used to be a private school, and the student remains at that school for many years. Finally, the fact that non-conversion charters performed about as well as conversion charters with stayer students, but performed less well than conversion charters overall, suggests that conversion charters outperformed non-conversion charters in our study specifically because they kept a higher proportion of their students in their school for the duration.

REFERENCES

Abdulkadiroglu, A., Angrist, J., Cohodes, S., Dynarski, S., Fullerton, J., Kane, T., & Pathak, P. (2009). *Informing the debate: Comparing Boston's charter, pilot and traditional schools.* Cambridge, MA: The Boston Foundation. Retrieved from http://www.gse.harvard.edu/~pfpie/pdf/InformingTheDebate_Final.pdf

Ballou, D.,Teasley, B., & Zeidner, T.(2006). *Charter schools in Idaho*. Nashville, TN: National Center for School Choice. Retrieved from http://www.vanderbilt.edu/schoolchoice/conference/papers/Ballouetal_2006-DRAFT.pdf

Bifulco, R., & Ladd, H.F. (2006). The impacts of charter schools on student achievement: Evidence from North Carolina. *Education Finance and Policy*, *1* (1), 50-90.

Booker, K., Gilpatric, S., Gronberg,T., & Jansen, D. (2007). The impact of charter school attendance on student performance. *Journal of Public Economics*, *91*(5-6), 849-876.

Borsuk, A. (2009, May 6). Charter schools seek to increase numbers, quality; national leader says the time is right to make impact. *Milwaukee Journal Sentinel*, p. B1.

Center for Education Reform (2011). *All about charter schools*. Retrieved on September 29, 2011 from http://www.edreform.com/issues/choice-charter-schools/facts/

Center for Research on Education Outcomes.(2010). *Charter school performance in New York City*. Stanford, CA: Center for Research on Education Outcomes. Retrieved from http://credo.stanford.edu/reports/NYC%202009%20_CREDO.pdf

Center for Research on Education Outcomes. (2009). *Multiple choice: Charter school performance in 16 states*. Stanford, CA: Center for Research on Education Outcomes. Retrieved from http://credo.stanford.edu/reports/MULTIPLE_CHOICE_CREDO.pdf

Cohen, J., & Cohen, P. (1983).*Applied multiple regression/correlational analysis for the behavioral sciences* (2nd Ed.).Hillsdale, NJ: Lawrence Erlbaum Associates.

Cowen, J., Fleming, D., Witte, J., & Wolf, P. (2010). *School and sector switching in Milwaukee*. Fayetteville, AR: School Choice Demonstration Project, retrieved from http://www.uark.edu/ua/der/SCDP/Milwaukee_Eval/Report_16.pdf

Evers, T., Pahnke, B., Soldner, R., McMurray, M., Golden, B., Holiday, L., Abel, J., Blaney, J., Wisconsin Department of Public Instruction, School Management Services. (2010). Wisconsin charter schools yearbook 2009-2010 (Bulletin No. 01063). Madison, WI: School Management Services. Retrieved from http://dpi.wi.gov/sms/pdf/2009-10yearbook.pdf

Finn, C. E., Jr., Manno, B.V., & Vanourek, G.(2001). *Charter schools in action: Renewing public education*. Princeton, NJ: Princeton University Press.

Gleason, P., Clark, M., Tuttle, C., Dwoyer, E., & Silverberg, M. U.S. Department of Education, Institute of Educational Sciences, National Center for Educational Evaluation and Regional Assistance. (2010). *The evaluation of charter school impacts: Final report* (NCEE 2010-4029). Washington, DC: U.S. Department of Education. Retrieved from http://ies.ed.gov/ncee/pubs/20104029/pdf/20104029.pdf

Hanushek, E., Kain, J., & Rivkin, S. (2004). Disruption versus Tiebout improvement: The costs and benefits of switching schools. *Journal of Public Economics*. *88*, 1721-1746.

Hanushek, E., Kain, J., Rivkin, S., & Branch, G. (2007). Charter school quality and parental decision making with school choice. *Journal of Public Economics*, *91* (5-6), 823-848.

Hill, P. Angel, L., & Christensen, J. (2006). Charter School Achievement Studies. *Education Finance and Policy*, 1 (1), 139-150.

Hoxby, C., Murarka, S., & Kang, J. (2009). *The New York City charter schools evaluation project: How New York City's charter schools affect achievement*. Cambridge, MA. The National Bureau of Economics Research. Retrieved from http://www.nber.org/~schools/charterschoolseval/how_NYC_charter_schools_affect_achievement_sept2009.pdf

Payne, C. & Knowles, T. (2009). Promise and peril: charter schools, urban school reform, and the Obama administration. *Harvard Education Review*, *79*(2), 227-239.

Peterson, P. E., & Llaudet, E. (August, 2006). *On the public-private school achievement debate*. Unpublished paper presented at the annual meeting of the American Political Science Association, Philadelphia, PA. Retrieved from http://www.allacademic.com//meta/p_mla_apa_research_citation/1/5/1/9/1/pages151912/p151912-1.php

Sass, T.R.(2006). Charter schools and achievement in Florida. *Education Finance and Policy*, *1* (1), 91-122.

School Management Services Team. (2011). *Currently operating charter schools*. Retrieved from http://dpi.wi.gov/sms/cs_currentChrSchs.html

Tuttle, C., Teh, B., Nichols-Barrer, I., Gill, B., & Gleason, P.(2010, June).*Student characteristics and achievement in 22 KIPP middle schools.* Washington, D.C.: Mathematica Policy Research. Retrieved from http://www.mathematica-mpr.com/publications/pdfs/education/kipp_fnlrpt.pdf

Wells, A (2002). *Where charter school policy fails: The problems of accountability and equity*. New York, NY: Teachers College Press.

Wisconsin Department of Public Instruction. (2011). *Wisconsin knowledge concepts examination (WKCE)*. Retrieved from http://dpi.wi.gov/oea/wkce.html

Witte, J., Weimer, D., Shober, A., & Schlomer,P. (2007). The performance of charter schools in Wisconsin. *Journal of Policy Analysis and Management*, *26* (3), 557-573.

Witte, J. & Lavertu, S. (2009). *The impact of Milwaukee charter schools on student achievement.* Washington, D.C. The Brookings Institution. Retrieved from http://www.brookings.edu/papers/2009/03_charter_lavertu_witte.aspx

Witte, J.F., Wolf, P.J., Dean, A., & Carlson, D. (2010). *Milwaukee independent charter schools study: Report on one year of student growth.* Fayetteville, AR: School Choice Demonstration Project. Retrieved from http://www.uark.edu/ua/der/SCDP/Research.html

Witte, J.F., Wolf, P.J., Dean, A., & Carlson, D. (2011). *Milwaukee independent charter schools study: Report on two- and three- year achievement gains.* Fayetteville, AR: School Choice Demonstration Project. Retrieved from http://www.uark.edu/ua/der/SCDP/Research.html

Zimmer, R., Gill, B., Booker, K., Lavertu, S., Sass, T., & Witte, J. (2009). *Charter schools in eight states: Effects on achievement, attainment, integration, and competition*. Santa Monica, CA: RAND Education.

Appendix A- Study Attrition

Missing and Non-Missing Students

About 34 percent of students in our sample were unable to be located in 2010-11. Missing students in the two samples are not the same as non-missing students. The relevant data are portrayed in Table A-1. Generally, missing students in 2010-11 exhibit baseline achievement which is higher in math than non-missing students. There are no differences, however, in baseline achievement in reading between the two samples. Students who are missing are more likely than non-missing students to be White, Hispanic, in grade 5, or in grade 8 at baseline. These students are also less likely to be Black, on free lunch, have a disability and be in grades 3 or 4 at baseline. It is important to note that these differences are not large and are controlled for in our statistical models presented in the text of this report.

Table A-1. Baseline Student Characteristics for Non-Missing and Missing Students in 2010-11

	Non-Missing	Missing Students
Average Mean Baseline Math	-.152**	-.083
Average Mean Baseline Reading	-.101	-.050
Female (%)	1,465 (49.19)	779 (49.94)
Black (%)	2,880*** (96.71)	1,479 (94.81)
White (%)	67** (2.25)	54 (3.46)
Hispanic (%)	25* (0.84)	22 (1.41)
Native American (%)	3 (0.10)	4 (0.26)
Asian (%)	3 (0.10)	1 (0.06)
Free Lunch (%)	2,334*** (78.71)	1,116 (71.54)
ExEd (%)	397*** (13.33)	159 (10.19)
Baseline Grade 3 (%)	600*** (20.15)	255 (16.35)
Baseline Grade 4 (%)	606*** (20.35)	224 (14.36)
Baseline Grade 5 (%)	522*** (17.53)	332 (21.28)
Baseline Grade 6 (%)	455 (15.28)	259 (16.60)
Baseline Grade 7 (%)	439 (14.74)	248 (15.90)
Baseline Grade 8 (%)	356*** (11.95)	242 (15.51)
TOTAL (N)	2,978	1,560

***p<0.01, **p<0.05, *p<0.10

Note: The average mean baseline math and reading scores are normalized z scores. Stars indicate that non missing students are different from missing students based on a two–sample difference in proportions test. Percentages are rounded to the nearest hundredth.

Missing Students Between Sectors

As indicated in Table A-2, there is considerable difference in the number of students missing in the two sectors, with 11.2 percent missing in MPS and 22.7 percent missing from the independent charters. Students in both independent charters and MPS may have left for private schools in the MPCP program or may have moved out of the city of Milwaukee. We have tracked students between sectors (i.e. "crossovers") using test score and enrollment data. We do not have the data to track students into private schools, which are likely to account for more missing students in the charter schools. Based on the results of previous longitudinal studies conducted in urban contexts, we anticipated sample attrition at 20 percent annually. As a result, we are pleased with the relatively low level of sample attrition.

Students who are missing in the two sectors for 2010-11 differ on some student characteristics. Compared to MPS students, independent charter students are less likely to be Black and in grade 3 at baseline. However, recall that the charter sample is overwhelmingly black to begin with (Table C2) so few students can comprise the racial difference. These same students are more likely to be Hispanic and in grade 6 at baseline (Table A-2). In addition, these students are more likely to score higher in math on average than their MPS counterparts, but there are no differences in reading.

Table A-2. MPS vs. Independent Charter Attrition Statistics for 2010-11

	MPS Matched	Independent Charter
Average Mean Baseline Math	-.151*	-.050
Average Mean Baseline Reading	-.066	-.043
Female (%)	244 (47.20)	535 (51.29)
Black (%)	502*** (97.10)	977 (93.67)
White (%)	14 (2.71)	40 (3.84)
Hispanic (%)	1*** (0.19)	21 (2.01)
Native American (%)	0 (0.00)	4 (0.38)
Asian (%)	1 (0.10)	1 (0.06)
Free Lunch (%)	378 (73.11)	738 (70.76)
ExEd (%)	74*** (14.31)	85 (8.15)
Baseline Grade 3 (%)	101** (19.54)	154 (14.77)
Baseline Grade 4 (%)	76 (14.70)	148 (14.19)
Baseline Grade 5 (%)	102 (19.73)	230 (22.05)
Baseline Grade 6 (%)	73* (14.12)	186 (17.83)
Baseline Grade 7 (%)	87 (16.83)	161 (15.44)
Baseline Grade 8 (%)	78 (15.09)	164 (15.72)
TOTAL (N) (%)	517	1,043

***p<0.01, **p<0.05, *p<0.10

Note: The average mean baseline math and reading scores are normalized z scores. Stars indicate MPS Matched different from Independent Charter statistics based on a two-sample difference in proportions test. Percentages are rounded to the nearest hundredth.

Appendix B- School Switching

The explanatory results for models including school switching are described below. We view school switching as a downstream mediator meaning that switching can be considered as a part of the treatment (independent charter school attendance). When we include school switching the charter main effects in math and reading continue to be non-significant, providing evidence that these students perform similarly to MPS students in this model (Table B-1, full sample). Estimating the models by charter school type, we find that the conversion charter effect becomes non-significant in reading after including school switching (Table B-2, full sample). Four-year math achievement gains for conversion charters and four-year achievement gains in both subjects for non-conversion charter schools remain non-significant, showing these students perform no differently from MPS students (Table B-2, full sample).

Results from regressions of stayers, students who remain in the same sector over the five years of the study, show some significant advantages for charter students after controlling for school switching. Specifically, charter students on average as well as conversion and non-conversion charter students separately, make greater four-year gains than MPS students in math (See Tables B-1 and B-2, stayers sample). Similarly, students in charter schools on average and conversion charters make higher four-year reading achievement gains.

However, switching schools among charter stayers is limited to 20 students, with only 2 students switching from conversion charter schools. What this may mean is that where there are positive effects of independent charter schools on average and by type, they may be partially explained by the greater stability of charter attendance after four years. Specifically, there are many fewer charter school students switching schools after four years. This could be an effect of family desire to remain in the specific charter school their child attends, a preference for independent charter schools in general, or that there are fewer switching choices available to them than to parents in MPS schools.

B-1. Estimates of Four-Year Gains for Charter Students in the Full Sample and the Stayers Sample Controlling for Switching from Initial School

	Model 4- Switching Estimates for Full Sample		Model 4- Non-Sector Switching Estimates for Stayers Sample	
	Math 2010	Reading 2010	Math 2010	Reading 2010
Charter 2006	-.022 (.042)	-.020 (.055)	.303*** (.083)	.193** (.074)
2006 Score - Reading	.183*** (.026)	.402*** (.026)	.170*** (.033)	.428*** (.036)
2006 Score - Math	.424*** (.030)	.204*** (.023)	.422*** (.042)	.181*** (.032)
Grade 7	-.293*** (.101)	-.324*** (.100)	-.185* (.102)	-.260*** (.088)
Grade 8	-.279** (.123)	-.291*** (.093)	-.126 (.119)	-.159* (.088)
Grade 10	-.399*** (.119)	-.381*** (.103)	-.193 (.125)	-.217** (.093)
Black	-.207*** (.069)	-.327*** (.075)	-.165** (.071)	-.301*** (.070)
Female	-.076 (.068)	.075 (.058)	-.022 (.050)	.101** (.047)
ExEd	-.230*** (.084)	-.383*** (.072)	-.295*** (.091)	-.384*** (.092)
Free Lunch	-.085* (.050)	-.105** (.051)	-.102 (.064)	-.103* (.060)
Switch School	-.383*** (.075)	-.348*** (.047)	-.159** (.079)	-.208*** (.067)
Constant	1.01*** (.133)	1.07*** (.115)	.602*** (.131)	.785*** (.121)
N	1556	1559	1068	1068
R^2	.486	.506	.512	.539
F	.	.	.	.

***p<0.01, **p<0.05, *p<0.10

Table results control for race, gender, grade, free lunch, exceptional education and switching schools. Reference categories for these variables are non-black, male, grade is 6 in 2010 for four-year gains model, no free lunch, no exceptional education and not switching schools, respectively. Two prior test scores are also controlled for in these models. Robust standard errors are estimated to account for the clustering of students within particular schools. Estimates for student characteristics, prior test scores and grade dummies are available upon request. F-tests cannot be computed using robust standard errors when a cell in the regression matrix is only a single student.

B-2. Estimates of Four- Year Gains for Conversion and Non-Conversion Charter Students in the Full Sample and the Stayers Sample Controlling for Switching from Initial School

	Model 4- Switching Estimates for Full Sample		Model 4- Non-Sector Switching Estimates for Stayers Sample	
	Math 2010	Reading 2010	Math 2010	Reading 2010
Conversion Charter 2006	-.057 (.059)	.051 (.064)	.243* (.115)	.219*** (.058)
Non- Conversion Charter 2006	-.009 (.048)	-.046 (.076)	.353*** (.091)	.170 (.117)
2006 Score –Reading	.184*** (.026)	.400*** (.025)	.171*** (.033)	.428*** (.036)
2006 Score- Math	.425*** (.031)	.203*** (.024)	.423*** (.042)	.180*** (.032)
Grade 7	-.293*** (.100)	-.325*** (.099)	-.181* (.099)	-.262*** (.089)
Grade 8	-.282** (.123)	-.285*** (.092)	-.126 (.116)	-.159* (.088)
Grade 10	-.398*** (.118)	-.385*** (.103)	-.186 (.121)	-.220** (.094)
Black	-.219*** (.065)	-.304*** (.072)	-.194** (.084)	-.288*** (.062)
Female	-.074 (.066)	.071 (.055)	-.017 (.048)	.098** (.046)
ExEd	-.226** (.086)	-.390*** (.070)	-.290*** (.092)	-.387*** (.092)
Free Lunch	-.093** (.048)	-.087* (.050)	-.116** (.059)	-.096 (.060)
Switch School	-.392*** (.079)	-.329*** (.054)	-.164** (.080)	-.205*** (.066)
Constant	1.03*** (.140)	1.02*** (.122)	.639*** (.139)	.769*** (.114)
N	1556	1559	1068	1068
R^2	.486	.506	.513	.539
F	.	.	.	.

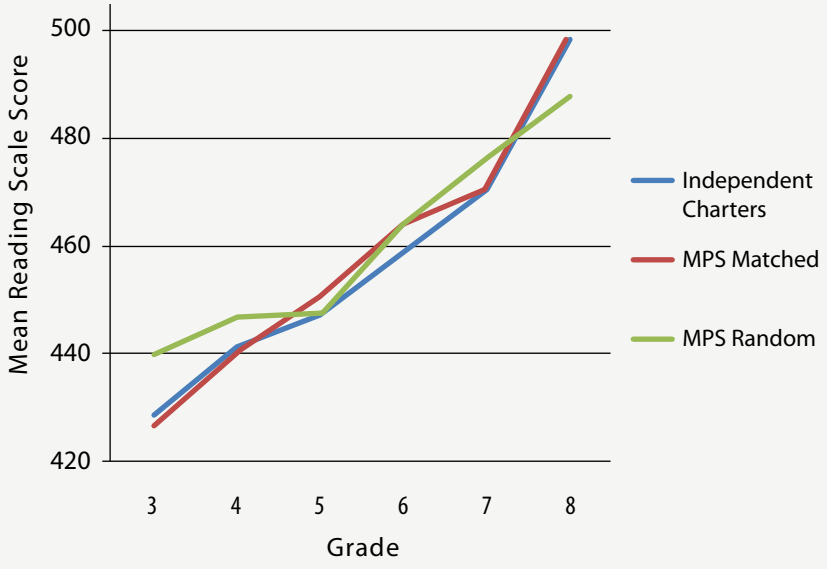
***p<0.01, **p<0.05, *p<0.10

Tabled results control for race, gender, grade, free lunch, exceptional education and switching schools. Reference categories for these variables are non-black, male, grade is 6 in 2010 for four-year gains model, no free lunch, no exceptional education and not switching schools, respectively. Two prior test scores are also controlled for in these models. Robust standard errors are estimated to account for the clustering of students within particular schools. Estimates for student characteristics, prior test scores and grade dummies are available upon request. F-tests cannot be computed using robust standard errors when a cell in the regression matrix is only a single student.

Appendix C- Matching Algorithm

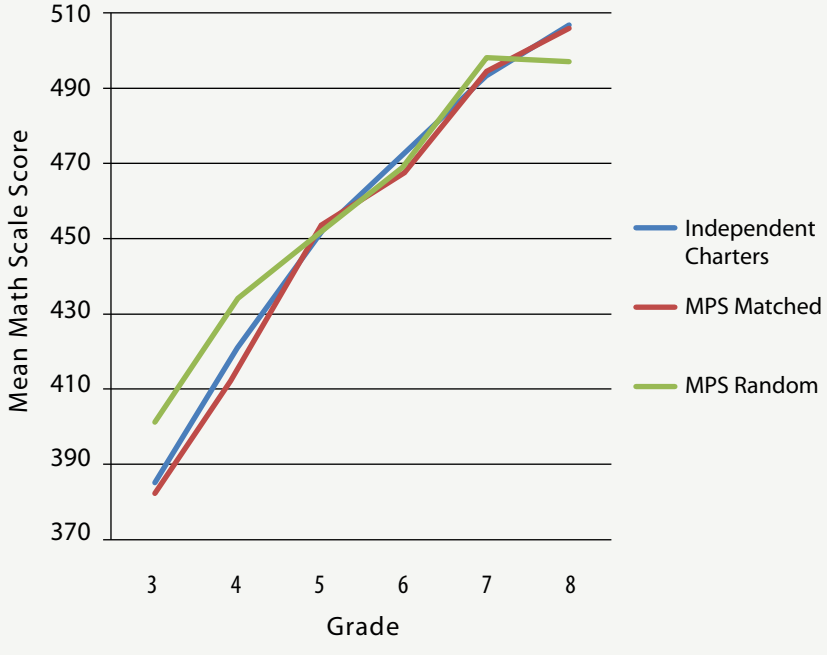
The first step in our analysis was to determine the comparative samples of students. Because the total number of students in independent charters for which test scores were available in 2006-07 was 2,295, we decided to include all of those students in the charter school sample. The issue was then how to create a relevant matched sample that would be similar on important observed characteristics at baseline. To do that we first selected a random sample of MPS students matched by grade. In doing so we discovered that the baseline test scores (November 2006) for that group differed from those in the independent charter schools in a number of grades. As depicted in Figures C1 and C2, the random MPS sample of students usually scored higher in 2006 than the independent charter students. Thus the random sample would have started out students at different levels of prior achievement.

Figure C1. Comparison of Baseline Reading Scale Score



To adjust for this problem we undertook a two-step procedure. First, each student in the charter panel was matched with the set of MPS students in their grade with baseline WKCE test scores within five percent of their score. There were 20 such bands with the lowest being scores from the first to fifth percentile, and the highest for those scoring from 95% to 100%. Second, the charter panelist and each MPS student within that five percent grade band were assigned a propensity score that predicted their likelihood of being in a charter school based on race, gender, English Language Learner (ELL) status, and participation in the federal Free/Reduced Price Lunch (FRL) program. The MPS student within the grade band with the charter school propensity score closest to the propensity score of a given student in the charter panel was drawn out of the panel (without replacement) to serve on the MPS comparison panel. The result of all these matches was a panel of 2,295 independent charter school students and 2,295 MPS comparison students that closely resemble the charter school students on baseline test scores and other factors that predict charter school enrollment.

Figure C2. Comparison of Baseline Math Scale Score



The purpose of this procedure was to reduce the differences in observed characteristics between the independent charter students and a random sample of MPS students. Figures C1 and C2 and Table C1 depict our success in improving on the extent to which our charter and comparison groups are carefully matched. These figures and table display mean comparisons by grade level for the three possible comparison samples.

In Figure C1, for reading, the Independent Charter Sample and MPS Matched Sample begin at similar points and converge in later grades. While there appears to be a gap over grades 5 through 7, these mean differences between the two sectors are not statistically significant. For math, in Figure C2, the charter and MPS matched samples are almost indistinguishable at all grades.

In Table C1, we see few statistically significant differences between means in reading and math scale scores when comparing the Independent Charter Sample and the MPS Matched Sample. With the exceptions of 4th and 6th grade math, this holds for every grade in both subjects. Both of those lingering differences between the charter and matched samples are statistically significant only at the 90 percent confidence level, the lowest confidence level that we use in this evaluation. This suggests the matching was successful. Thus, in terms of prior achievement we have created samples that are essentially equal at baseline.

Table C1. Baseline (2006-07) Scale Scores of Independent Charter, MPS Matched, and MPS Random Samples

Grade	Sample	N	Mean Reading Scale Score	Reading SD	Mean Math Scale Score	Math SD	Comb Mean Scale Score	Combined SD
3	Independent	430	429	47	385	49	407	44
3	MPS Matched	431	427	47	383	47	405	42
3	MPS Random	341	440***	38	402***	50	422***	40
4	Independent	417	441	49	421	48	431	45
4	MPS Matched	420	440	53	415*	54	428	50
4	MPS Random	324	447	53	434***	47	441***	47
5	Independent	427	447	51	452	48	450	46
5	MPS Matched	430	451	49	454	41	453	40
5	MPS Random	338	448	56	452	44	451	47
6	Independent	358	460	51	473	48	466	46
6	MPS Matched	356	464	50	467*	40	466	41
6	MPS Random	330	464	54	469	44	468	44
7	Independent	346	470	51	493	43	482	44
7	MPS Matched	341	470	45	496	38	483	38
7	MPS Random	303	468	49	499	47	488*	44
8	Independent	298	499	47	507	48	503	43
8	MPS Matched	299	499	50	506	45	503	43
8	MPS Random	290	488**	55	497**	50	493**	53

***Different from Independent Charter at p<0.01, **Different from Independent Charter at p<0.05,
*Different from Independent Charter at p<0.10

Table C2 indicates that our matching algorithm was successful in producing a matched sample with important measurable student characteristics that, though imperfect, are closer than in the random sample. The matched and charter samples are very close on race and gender. Although the matched MPS sample contains populations of exceptional education and free lunch students that are closer to the charter sample than the random sample provided, the MPS Matched sample does differ significantly from the Independent Charter Sample regarding these two student characteristics.[14]

Table C2. Comparison of Student Characteristics in Three Possible Study Samples

Sample	Black (%)	White (%)	Hispanic (%)	Female (%)	ExEd (%)	Federal Lunch (%)	ELL (%)
Independent Charter	93.93	3.86	1.80	49.67	8.38	51.64	0.04
MPS Matched	98.19***	1.44***	0.26***	49.45	16.07***	73.82***	0.04
MPS Random	59.91***	14.52***	19.76***	48.29	19.47***	83.68***	13.27***

Stars indicate MPS Matched and MPS Random different from Independent Charter at ***p<0.01, **p<0.05, *p<0.10, based on a two-tailed t-test.

14 The initial difference between the charter and matched sample on free lunch status is due to incomplete free lunch data counts in a few schools. We correct for this in our models in two ways. If a student had a free lunch observation in 2007-08, 2008-09 or 2009-10, we back-filled the data. In addition, for students with missing data on free-lunch or any other control variable, we include an indicator in our models controlling for this missing data. Doing so allows our regression models to draw upon the actual data in each student observation, and only that actual data, to inform the coefficient estimates of the model (Cohen and Cohen 1983).

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