



Direct and indirect impact of charter schools' entry on traditional public schools: New evidence from North Carolina



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HIGHLIGHTS

- Estimate the causal impact of school choice programs on student achievement.
- Separately identify direct impact and indirect impact at the grade level.
- Find a positive and significant direct impact on student achievement.
- Demonstrate such positive effects were significantly undervalued in the literature.

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ABSTRACT

This paper examines the effects of charter schools on student achievement at neighboring traditional schools. The study shows that charter school entry does not induce indirect impact on non-overlapping grades but generates positive direct impact on overlapping grades. I also demonstrate that such positive effects would have been significantly undervalued in prior studies, since they do not distinguish between the two impacts.

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1. Introduction

School choice programs have played a key role in public education reform in the United States over the past several years. Such programs introduce market mechanisms into public education and allow students to easily switch from their current school to an alternative public school, generating strong pressure on schools to avoid losing students and public funding. While there are a wide variety of school choice programs, charter school policies have been rapidly growing since 1991, when Minnesota enacted the nation's first charter school legislation. In 2013, 6.3% of all public schools nationwide were charter schools, and this figure is expected to further increase in the future (The National Alliance for Public Charter Schools).

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Like traditional public schools, charter schools are publicly funded and free to all students.¹ Unlike traditional schools, however, charter schools are not geographically restricted by school district or attendance zone. Wherever they live, parents are able to enroll their children in any charter school rather than an assigned traditional school.² In this regard, charter schools provide parents and children with an alternative choice to traditional schools and thus have a potential to improve the quality of neighboring traditional schools through competition. If traditional-school students leave for charter schools, traditional schools will lose public funding; this is the financial pressure

¹ Charter schools are typically exempt from a number of local regulations and have considerable freedom in personnel and curricular decision-making. However, charter schools can be closed due to poor student performance or financial mismanagement.

² Charter legislations vary from state to state; some states allow students to attend a charter school only across attendance zones, while other states allow attendance even across school districts. If oversubscribed, charter schools are required to select students by lottery.

Table 1
The number of schools by grade in North Carolina in 2010.

	Lowest grade	Highest grade	Traditional public school		Charter school	
			Number	Percentage	Number	Percentage
Elementary	Pre-K	5	459	19.0	0	0.0
	K	5	616	25.5	9	9.4
Middle	6	8	405	16.8	4	4.2
High	9	12	437	18.1	7	7.3
Combined	Pre-K	6	40	1.7	1	1.0
	Pre-K	8	46	1.9	1	1.0
	K	6	23	1.0	2	2.1
	K	8	28	1.2	41	42.7
	K	12	13	0.5	17	17.7
	5	8	21	0.9	1	1.0
	6	12	45	1.9	2	2.1
	7	12	13	0.5	0	0.0
	Other	Other	265	11.0	11	11.5
Total	–	–	2411	100	96	100

Note: Grade Pre-K indicates pre-kindergarten, while K indicates kindergarten. The numbers of schools for traditional schools and charter schools include only regular schools. Alternative schools or vocational schools are excluded.

that traditional schools face when a charter school opens in their neighborhood and that policymakers hope will induce additional effort from traditional schools.

To date, no consensus has been reached regarding the direction, let alone the existence, of the effects of charter schools on neighboring traditional schools, as the literature on this topic finds conflicting results: positive effects (Booker et al., 2008; Hoxby, 2004; Holmes et al., 2003; Sass, 2006; Winters, 2012), no effects (Bettinger, 2005; Bifulco and Ladd, 2006; Buddin and Zimmer, 2009), and negative effects (Imberman, 2011) on student test scores at traditional schools.³ But more importantly, these studies have potentially resulted in biased estimates by not separating two distinct effects of charter schools on traditional schools: direct impact and indirect impact.

In this paper, I propose a new empirical approach to identify the impact of charter schools on local traditional schools. Specifically, I define *direct impact* as the effect of introducing charter schools on traditional-school students in grades that overlap with charter schools' grades, while *indirect impact* is defined as the effect on students in non-overlapping grades. Unlike prior research work, which estimates the effects of charter school entry at the school level, I examine the effects at the grade level by exploring the variation in gaps between grades offered by charter schools and grades at nearby traditional schools. In fact, at their inception, charter schools tend to be small-sized schools that expand their grade ranges over years. Thus, when charter schools are introduced, grade ranges are not likely to overlap entirely between charter schools and traditional schools. Some traditional-school grades have their counterparts at charter schools, while others do not.

Separating the direct and indirect impact is critical to consistently estimate the effects of charter schools, since traditional-school students are not equally affected by the introduction of charter schools. For example, when a charter school opens with grades kindergarten (K) through 3, a neighboring K–5 traditional school will compete only for students at grades K through 3. Although the charter school operates in their neighborhood, traditional-school students at grades 4 and 5 have no choice but to stay at the current school. Therefore, to the extent that the direct and indirect impacts are distinct, examining the effects of charter school entry at the school level, as in other related studies, is bound to introduce bias to the ultimate impact of charter schools.

Using student-level panel data from North Carolina, this paper shows that the introduction of charter schools does not induce any significant indirect impact on non-overlapping grades but generates a positive and significant direct impact on student achievement at overlapping grades. I also demonstrate that such positive effects would have been undervalued by as much as 48% in the literature, since previous work identifies the impact of charter school entry at a moment when the direct and indirect impacts are likely to be mixed. My approach in this paper brings new insight into the controversial literature and contributes to a better understanding of charter-school effects.

2. Charter schools in North Carolina

North Carolina, which is known for public education reforms, opened its first charter school in the 1997–1998 school year (1998 hereafter), and as of 2010 there were ninety-six charter schools in the state. Table 1 illustrates the numbers and proportions of traditional schools and charter schools in 2010 by grade-levels. In North Carolina, there is a huge variation in grade levels that both types of schools offer. While many elementary schools have grades that begin from pre-kindergarten (Pre-K) or kindergarten (K) and terminate at grade five, other schools have grades up to six or eight. Middle schools and high schools also demonstrate a similar pattern; although their grade ranges are traditionally 6–8 and 9–12, respectively, some schools have different grade ranges.

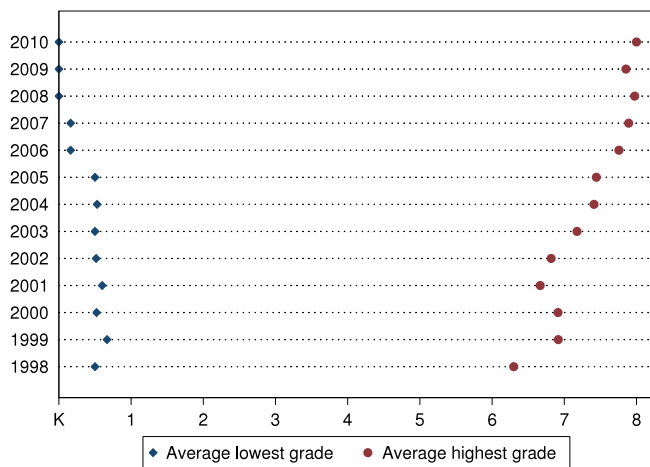
Regarding the grades offered by charter schools, a unique feature is that they expand their grades over time. Table 2 shows the average lowest and highest grades of charter schools, demonstrating that they are likely to expand their grades upward over years. Another debate on charter schools surrounds political regulations. The charter school law in North Carolina limited the number of charter schools to a total of one hundred. As a result, few charter schools have been allowed to open for the past several years, when the quota was almost reached. The reason for this cap on charter schools is the controversy over whether charter schools improve or harm the quality of neighboring traditional schools. Therefore, assessing the impact of charter schools is particularly informative for North Carolina.

3. Data

This paper accesses two kinds of datasets in North Carolina through the North Carolina Education Research Data Center. The first dataset is End-of-Grade (EOG) which includes student test scores as well as other student characteristics such as parent

³ Using data from school choice programs in Chile and Britain, respectively, Hsieh and Urquiola (2006) and Clark (2009) find no evidence that choice improved student achievement.

Table 2
The expansion of grades offered by charter schools.



education level and eligibility for free or reduced-priced lunch.⁴ The second dataset is the Common Core of Data Public School Universe survey (CCDPSU) which includes school characteristics such as the student–teacher ratio and racial composition. More importantly, CCDPSU also has information on the grade spans covered by both charter schools and traditional schools: the information I use to define the direct and indirect impacts of charter schools on traditional schools. In my analysis, I use the data from the EOG and the CCDPSU for 1997 through 2005. As described, 1997 was one year prior to the entry of the first charter schools in North Carolina.

Table 3 demonstrates descriptive statistics that show several remarkable differences in both student and school characteristics between charter schools and traditional public schools in North Carolina. In 1998, when the first charter schools opened, as well as in 2005, the proportion of black students at charter schools was higher than that at traditional schools. The parents of charter-school students, on average, had higher education levels than the parents of traditional-school students. In addition, charter students were less likely to be considered of Limited English Proficiency. However, test scores of charter school students were markedly lower than those of their counterparts in both reading and math. Regarding school characteristics, the average size of charter schools, measured by school and grade enrollment, was much smaller than that of traditional schools. Although some differences, such as achievement gap, between charter schools and traditional schools have been reduced over time, similar disparities continue to exist.

For my estimation, I combine EOG with CCDPSU and obtain a sample of traditional-school students who entered third-grade between 1997 and 2000 and completed eighth-grade between 2002 and 2005. The sample contains 1,884,545 student–year observations from 1997 through 2005 (455,753 distinct students for 1,744 schools). These numbers imply that, on average, students stay 4.1 consecutive years at traditional schools.

4. Empirical strategy

In this paper, I explicitly separate grade-level direct impact and indirect impact. Let Y_{ijgt} denote student i 's test score, in math and reading respectively, at grade g of traditional school j in year t . Test scores are standardized with mean zero and standard deviation one for each subject, grade, and year.

Following the literature, the econometric specification in this study is as follows.

$$Y_{ijgt} = X_{ijgt}\beta + \alpha_0 \text{Direct}_{jgt} + \alpha_1 \text{Indirect}_{jgt} + \eta_{ij} + \delta_{gt} + \epsilon_{ijgt}$$

where X_{ijgt} controls for student and school characteristics: school-level enrollment, minority share, proportion of students who are eligible for free or reduced-priced lunch, and an indicator whether a student switched a school from the previous year. Direct_{jgt} and Indirect_{jgt} are the grade-level indicators for direct and indirect charter penetration defined by the numbers of charter schools within 2.5 miles, as same as in Bifulco and Ladd (2006) and Sass (2006). Student–school fixed effects η_{ij} capture unobserved heterogeneity, while grade-by-year fixed effects δ_{gt} capture any systematic differences across exams over years. The parameters of interest are α_0 (direct impact) and α_1 (indirect impact): the effects of charter schools on the student achievement at neighboring traditional schools.

With this identification strategy, this study estimates the impact of charter schools based on the changes in the achievement level of individual students in the same schools. More specifically, those students who stay at the same school both before and after the establishment of a charter school contribute to identification. Table 4 presents the cohorts of students in the sample. Each student's exam scores are available for the third grade through the eighth grade. Table 5 shows the proportion of observations under the pressure from charter schools (both direct and indirect). In total, 7.8% of school-grade-year observations at traditional schools face direct competition with charter schools, while 1.3% face indirect competition. A closer look at the data for each grade confirms that there is a variation across grades. All traditional-school grades face both direct and indirect pressure from nearby charter schools, which contributes to identifying the direct and indirect impacts separately.

5. Results

Table 6 presents the main estimation results for math scores (Columns 1–3) and reading scores (Columns 4–6). Column (1) shows the baseline OLS estimates that include only grade-by-year fixed effects δ_{gt} . The grade-level direct impact of charter schools on student achievement at neighboring traditional public schools is 0.066 with significance at the 1% level. The estimate suggests that math scores for traditional school students, at overlapping grades with competing charter schools, increase by 0.066 standard deviations (s.d.) as one charter school opens in a neighborhood. By contrast, the indirect impact of charter schools on students at non-overlapping grades is not significant.

Column (2) adds school fixed effects γ_j to the baseline regression. The estimate of direct impact is 0.041 and that of indirect impact is -0.001 ; both estimates are lower than those in Column (1). These results suggest that the simple OLS estimates were biased upward because of the positive correlation between charter schools' location decisions and unobserved quality of traditional schools; that is, charter schools are likely to enter districts where the quality of local traditional schools is high.

Column (3) introduces student–school fixed effects η_{ij} , leading to the preferred specification. The estimate of the direct impact further drops from that of school fixed effects model, implying the positive correlation between students' decisions to stay at traditional schools and students' unobserved characteristics; that is, low-performing students are likely to switch to a charter school.

The key finding is that entry of a charter school improves student achievement in math by 0.033 s.d. at overlapping grades

⁴ Charter schools are also subject to the same statewide testing requirements and accountability standards as traditional schools.

Table 3
Descriptive statistics of charter schools and traditional public schools.

	1998		2005	
	Charter	Traditional	Charter	Traditional
Total number of schools	31	1593	87	1710
Total number of students	2558	548,129	13,443	607,101
<i>Panel A: Student characteristics</i>				
<i>Ethnicity</i>				
White	0.566 (0.496)	0.651 (0.477)	0.595 (0.491)	0.576 (0.494)
Black	0.380 (0.486)	0.290 (0.454)	0.324 (0.468)	0.292 (0.455)
Hispanic	0.008 (0.090)	0.022 (0.148)	0.028 (0.165)	0.072 (0.258)
<i>Parent education</i>				
Less than high school	0.049 (0.216)	0.108 (0.310)	0.032 (0.175)	0.091 (0.288)
High school	0.253 (0.435)	0.436 (0.496)	0.283 (0.450)	0.412 (0.492)
College	0.299 (0.458)	0.207 (0.405)	0.368 (0.482)	0.227 (0.419)
Graduate school	0.111 (0.314)	0.055 (0.227)	0.076 (0.265)	0.048 (0.214)
<i>Limited English proficiency</i>	0.001 (0.028)	0.009 (0.097)	0.010 (0.100)	0.036 (0.187)
<i>Panel B: Student achievement</i>				
Reading	−0.1064 (1.12)	0.0005 (1.00)	0.0061 (1.00)	−0.0001 (1.00)
Math	−0.2625 (1.15)	0.0012 (1.00)	−0.1082 (1.00)	0.0024 (1.00)
<i>Panel C: School characteristics</i>				
School enrollment	140.5 (100.8)	558.0 (232.2)	249.5 (193.3)	553.4 (235.8)
Grade enrollment	37.7 (64.5)	164.2 (140.4)	41.0 (32.1)	162.0 (142.2)
Student/teacher ratio	– (–)	14.8 (2.2)	13.9 (5.1)	15.0 (3.8)
Free lunch eligibility (%)	– (–)	38.2 (19.3)	22.3 (30.2)	43.5 (21.1)

Note: North Carolina EOG and CCDPUG. Standard deviations are in parenthesis. Test scores are standardized for each year, grade, and subject at mean zero and standard deviation one.

Table 4
Cohorts and grades of the sample.

	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cohort 1	3	4	5	6	7	8			
Cohort 2		3	4	5	6	7	8		
Cohort 3			3	4	5	6	7	8	
Cohort 4				3	4	5	6	7	8

Note: Cohort 1 consists of students who entered third grades in 1997; other cohorts are defined in the similar manner.

Table 5
Percentage of grades that face competition from charter schools.

	Direct	Indirect
Total	7.8	1.3
Grade 3	5.2	0.6
Grade 4	7.6	0.9
Grade 5	9.4	1.6
Grade 6	8.3	0.5
Grade 7	8.9	1.8
Grade 8	9.2	3.0

Note: Observations are at the school-grade-year level.

of nearby traditional schools, while the entry does not have any significant impact on students at non-overlapping grades.⁵

Columns 4–6 show the results for reading scores. Likewise, the estimates from the preferred specification (Column 6) demonstrate that the direct impact is positive, while the indirect impact is not significant. Compared to the results for math scores, the magnitude for reading test is smaller, which is consistent with findings from a wide variety of studies on education.

The main results show that, for both math and reading, charter schools induce positive direct impact and no indirect impact, which are reasonable as two types of schools are competing for students only at overlapping grades. By using a single indicator of competition, this study further points out that estimates of previous studies were potentially biased by not separating these two different impacts. To estimate the school-level effects of

⁵ These results were robust to several specifications including growth-score model and lagged-score model. The positive direct impact is also economically

significant, as Kane et al. (2008) find that students assigned an experienced teacher, compared to a new teacher, have an increase of 0.08 s.d. in math.

Table 6

Direct and indirect impacts of charter schools on traditional public schools.

	Grade-level impact						School-level impact	
	Math			Reading			Math	Reading
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Direct	0.066*** (0.019)	0.041*** (0.010)	0.033*** (0.008)	0.064*** (0.015)	0.025*** (0.008)	0.017*** (0.005)		
Indirect	0.048 (0.038)	−0.001 (0.012)	−0.013 (0.009)	0.063*** (0.023)	0.011 (0.008)	0.002 (0.006)		
Competition							0.017*** (0.007)	0.012*** (0.004)
Grade-year FE	✓	✓	✓	✓	✓	✓	✓	✓
School FE		✓			✓			
Student-school FE			✓			✓	✓	✓
N	1,883,245	1,883,245	1,883,245	1,861,142	1,861,142	1,861,142	1,883,245	1,861,142

Note: The dependent variable is test score in math. All regressions include an indicator whether a student switched a school from the previous year as well as school-level enrollment, minority share, and proportion of students who are eligible for free or reduced-priced lunch. Robust standard errors clustered by school are in parentheses.

*** Denotes significance at the 1% level.

charter schools (Columns 7 and 8), I combine the two grade-level indicators of $Direct_{jgt}$ and $Indirect_{jgt}$ into a single school-level indicator of $Competition_{jt}$, which was used in the literature. That is, I define $Competition_{jt}$ as the number of charter schools, within 2.5 miles from traditional public school j in year t , that have at least one overlapping grade with the traditional school.

The results demonstrate that for both math and reading such school-level effects are significantly smaller than grade-level effects (by 48% in math and by 29% in reading), implying that previous studies have substantially undervalued the effects of charter schools by not separating the direct and indirect impacts of charter schools. This highlights the importance of distinguishing between the two distinct grade-level impacts.

6. Conclusion

Charter schools have become one of the most widely used alternatives to traditional public schools and have received nationwide attention for the past several years. Clearly, they have the potential to generate strong incentives for principals of neighboring traditional schools to improve their institutions. Otherwise, traditional schools can lose their students as well as public funding. However, there has been no consensus in either the political or academic spheres regarding the direction, let alone the existence, of the impact of charter schools.

This paper contributes to this controversial literature by proposing a new empirical strategy to consistently estimate the effects of charter schools on nearby traditional public schools. Specifically, I distinguish between grade-level direct and indirect impact of charter schools, taking into account the grade expansion of charter schools. While previous studies estimate the effects at the school level, this paper is the first to differentiate between the two distinct grade-level impacts. As a result, I find positive direct impact on overlapping grades at nearby traditional schools and insignificant indirect impact on non-overlapping grades. These results reveal that the literature has substantially undervalued the effects of introducing charter schools by not separating the two distinct impacts.

Given a clearer understanding of charter-school effects, previous studies should be revisited to resolve the debate. This study's new evidence and insights will also help policy-makers reconsider the current design and regulation of charter school programs.

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