The Effect of Charter Schools on District Costs and Efficiency: The Case of New York State

Abstract

This paper estimates how charter schools influence the cost and efficiency of providing education in traditional public schools. Charter schools can influence the costs of providing education by reducing economies of scale and by changing the share of high cost students the district serves. They might also increase district efficiency through competition. This paper is the first to estimate the net of both mechanisms. Utilizing data for New York State school districts from 1998/99 to 2013/14, we estimate difference-in-differences models to assess the effect of charter schools on enrollment and the percentages of students in various need categories. Then, we estimate an expenditure function that controls for student test scores, costs factors, and other factors that might influence district efficiency to measure changes in district efficiency associated with charter school entry. We find that charter schools increase the cost of providing education and increase efficiency. Specifications breaking down the post period in different time intervals find efficiency gains that increase over time.

APPLICATIONS FOR PRACTICE

- Our conceptual framework establishes that charter schools can influence the cost and efficiency of providing education in traditional public schools.
- We estimate how charter schools impact the costs and efficiency of providing education in school districts.
- We provide evidence that efficiency gains are greater than cost increases and that these gains increase over time.

INTRODUCTION

Charter schools are publicly funded schools that operate under contract with an authorizing agency specified by state law. Charter schools are usually open to all who wish to attend within a given geographic area, and cannot charge tuition. However, students are not automatically enrolled into a charter school, but are admitted only upon application. Oversubscribed charter schools are typically required to admit students using a lottery (Bulkley and Bifulco 2015; NASPC 2015). Charter schools typically have extensive autonomy over their operations. For instance, in most states, charter schools choose their own curriculum and decide over salaries and benefits outside union contracts. In return for funding and autonomy, they must meet accountability standards specified in their contract with the authorizing agency. Authorizing agencies differ between states but almost always include local school boards and state boards of education. The contract lasts for a set number of years and must be renewed for the school to continue receiving public funding.

Choice advocates have argued organizational autonomy and the pressure to compete for students makes charter schools more innovative and of higher quality than traditional public schools. Additionally, by creating competition for district schools, they are seen as "a tide that lifts all boats" increasing school quality for all public school students (Friedman, 1955, 1962; Hoxby, 2002, 2003a, 2003b). Charter schools are also recognized as an opportunity to overcome the isolation of students trapped in low performing school districts (Viteritti 1999). School choice opponents, on the other side, have worried that charter school programs may increase segregation and the isolation of disadvantaged students (Cobb and Glass 1999; Frankenberg et al. 2010). Further, they have raised concerns that charter schools drain resources from traditional public schools and increase per pupil costs by attracting students that are less costly to educate (Arsen et al. 1999; Moodey's 2013; Molnar 1996).

A few studies have examined the impact of charter schools on district finances and expenditure choices (Arsen & Ni 2012; Bifulco & Reback 2014; Welsch 2011), and at least one has directly examined the cost and efficiency of charter schools relative to traditional public schools (Gronberg, Jansen, and Taylor 2012). Also, several studies have tried to estimate the effect of charter schools on the performance of students who remain in traditional public schools (Booker et al. 2008; Bettinger 2005; Imberman 2011; Ladd et al. 2017). But none of these studies directly address the effect of charter schools on traditional public school district costs and efficiency.

This study draws on concepts from the literature on educational costs to estimate the effect that charter schools have on the amount of per pupil expenditures districts spend to achieve a given level of student outcomes (Duncombe and Yinger 1998, 2005, 2008, 20011a, 2011b). We posit that charter schools can affect the minimum costs required to achieve a given level of student outcomes by influencing the level of enrollment in the district and/or the proportion of students with relatively high needs. Competition from charter schools can also influence district efficiency, i.e. how much district expenditures exceed minimum costs given current technology. More specifically, we investigate the following three research questions: 1) What is the impact of charter schools on costs in traditional public schools? 2) How does charter school competition affect school district efficiency? and 3) What is the net effect of changes in cost and efficiency for traditional public schools?

Our empirical strategy builds on techniques applied in program evaluation (Card and Krueger 1994; Angrist and Pischke 2008) and education cost-function research (Duncombe and

Yinger 1998, 2005, 2008, 2011a, 2011b). Utilizing data from New York State, we start with using difference-in-differences models to estimate the effect of charter school entry on district enrollment and the percentages of students in various need categories. Next, we estimate an expenditure-function that controls for service outcomes, district costs, and other factors that might influence district efficiency. We include a charter school identifier in these expenditure models to measure how charter schools influence school district efficiency. Finally, using estimates from the same expenditure-function and the difference-in-differences models, we calculate changes in district costs and compare them with the charter school efficiency effects.

Our findings suggest that charter schools decrease enrollment, increase the share of poor and disabled students, and decrease the share of students with limited English proficiency in traditional public schools. These findings are consistent with research showing that charter schools reduce the number of students in traditional public schools (Arsen and Ni 2012; Bifulco and Reback 2014), enroll lower shares of students with disabilities (Jabbar 2016), admit greater shares of high performing students from public schools (Welner 2013; West et al. 2006; Ladd et al. 2017), and target certain groups of students and specialize in educating them (Thernstrom and Therstrom 2003). Together, these effects increase the minimum per pupil amount a typical sized district has to spend for reaching a given level of performance by 2.45 percent in the short-term and 3.45 percent in the longer-run. Although we caution that these estimates have a large confidence intervals around them.

Our results also suggest that efficiency gains in response to charter schools decrease the amount districts spend to achieve a given level of outcomes by 3.29 in the short-term and 6.99 percent in the longer-run. The finding is consistent with literature showing that charter school entry leads to improved service provision in traditional schools (Booker et al. 2008). Therefore, comparing cost increases and efficiency gains, charter schools reduce the expenditure per pupil used to reach a given performance level, by 0.84 percent in the first four years and by 3.54 percent five to eight years after charter school entry.

Our findings contribute to the emerging literature on charter school finances in the following ways. First, our study establishes, theoretically and empirically, that charter schools influence the cost and efficiency of providing education and that both of these factors have to be considered in estimating the net effect of charters on spending in traditional public schools. Second, we develop an approach that combines methods from the program evaluation and the cost function literatures to estimate the effects of charter schools on school district expenditures—clarifying both the strengths and limitations of the approach. Finally, we provide evidence that the entry of charter schools in New York has both increased the per pupil cost of education and increased efficiency in traditional school districts.

The remainder of the article is organized as follows. Section 2 describes the charter school program in New York State. Sections 3 and 4 lay out the key conceptual considerations that guide the interpretation of our analysis and outline our empirical strategy. Section 5 describes the sample and measures we use to implement our empirical strategy. Section 6 presents the results of our analysis and Section 7 summarizes our conclusions.

NEW YORK STATE CHARTER SCHOOL PROGRAM

In New York State, the first charter schools started operating in the fall of 1999. Students can apply for admission to charter schools, which select students by lottery if they are oversubscribed. Although students outside the district where a charter school is located can be admitted, the lottery process gives preferences to students residing in the district where the charter school is located (NYS Charter School Law Subsection 2854 (2b)).

A charter school's primary source of funding in New York State is per pupil payments from the districts in which their students reside. The amount a district pays per student is equal to the approved operating expenses per pupil in the district. Charter schools receive additional funding for students with disabilities. The additional weight students with disabilities receive in the funding formula varies between 1.65 for students with severe disabilities and 0.9 for students with less severe disabilities. Charter schools do not receive additional funding for students with limited English proficiency or living in poverty. Further, the districts provide textbooks, software, transportation, health and special education evaluation services to charter schools. (NYS Charter School Law Subsection 2853).

Charter schools are closely regulated by the charter school authorizers, which include the SUNY Board of Trustees and the State Board of Regents. Additionally, local school district boards are able to approve districts schools converting to charter schools, with final approval given to the State Board of Regents. The National Alliance of Public Charter Schools identifies New York as being among the states using comprehensive monitoring and data collection as well as clear renewal, nonrenewal, and revocation processes to oversee charter schools (NAPCS 2017).

For data availability reasons, we focus on charter schools outside New York City (NYC) in this study. Table 1 shows the 20 districts outside NYC that have or have had charter schools since 1999/00. The first charter school was opened in Albany in the fall of 1999. The highest counts of charter schools are in Albany, Buffalo, and Rochester. Albany, Buffalo, and Lackawanna have the highest shares of charter school enrollments with more than 20 percent of resident public school students attending charter schools in these districts.

For purposes of defining which districts are exposed to charter school competition, it is worth noting that all of the districts that have substantial charter school enrollments (more than 3 percent) also have high shares of low-income students (more than 39 percent free-lunch eligible). In contrast, even when charter schools locate in districts with low levels of poverty, only small numbers of students from these districts choose to attend charter schools. For a handful of charter schools, including those located in Greece, Ithaca, Kenmore-Tonawanda, and Roosevelt, the majority of their enrollments are drawn from outside the district where they are located. With the exception of Roosevelt, the districts where these charter schools are located have low levels of charter school enrollment themselves and low levels of poverty, while the adjacent districts that send the majority of students to the charter school have high shares of charter school enrollment and high percentages of students receiving free lunch. So it appears that districts with relatively high percentages of low-income students (above 39%) and that have charter schools located within their boundaries or in an adjacent school district are subject to charter school competition.

<Table 1>

CONCEPTUAL CONSIDERATIONS

Analysis can focus on the impacts of charter schools on the public school system as a whole, including charter and traditional public schools, or on the traditional public schools themselves. Estimates of impacts on the entire system of public schools and thus, all public school students, would provide a more comprehensive picture. However, much of the discussion of charter schools has focused on the impacts on traditional public schools, including the questions of whether or not charter schools drain resources, cream-skim low cost students, or push traditional public schools to operate more efficiently. For this study, reliable fiscal data on charter schools is not available in a form that is comparable to that available for traditional public school districts, and so we focus on the effects of charter schools on traditional public schools.

We use a cost-function approach to characterize the relationship between spending, student performance, and other school district characteristics. Costs are defined as the minimum spending required to reach a given level of student performance using current best practices. Because not all districts operated efficiently and we cannot directly observe which districts are and are not efficient, costs cannot be observed directly and cost-functions have to be estimated using district spending as the dependent variable and controls for efficiency. Spending is greater than costs when school districts are inefficient and deviate from current best practices (Downes and Pogue 1994; Duncombe and Yinger 1998, 2005, 2008, 2011a, 2011b; Reschovsky and Imazeki 2001, 2003).

More formally, education costs, *C,* are determined by student performance, *S*, resource prices *W*, student composition *P*, and enrollment, *N*. If we let *e* stand for school district efficiency with a value of 1 in an efficient school district and a value between zero and one for an inefficient district, then the expenditure-function can be written as:

$$E = \frac{C(S, W, P, N)}{e}$$

Charter schools can influence a district's costs in at least wo ways. First, if there are economies of scale in education, then sufficiently large reductions in district enrollments due to students transferring to charter schools will increase the amount of per pupil expenditure required to achieve a given level of service outcomes. Second, charter schools potentially change the composition of students remaining in district schools. For instance, some studies have found that students from low-income families, with limited English proficiency (LEP), and/or disabilities are less likely to transfer to charter schools than other students (Jabbar 2016; West et al. 2006). If so, then charter school entry will increase the proportion of students in district schools with high levels of educational need, and thus, will increase the costs of achieving a given level of student outcomes.

Charter schools may also influence the efficiency with which a school district operates. Advocates of expanding public school choice have argued that forcing public schools to compete for students will provide incentives for districts to improve services (Hoxby 2000; Hoxby 2003a,b). If districts respond to charter school competition by adopting new educational programs or by reallocating resources from less to more productive uses, this could increase district efficiency. There are also reasons to believe that charter school competition might reduce the efficiency with which districts operate. First, Rockoff (2010) and Duncombe and Yinger (2011a,b) argue that it takes time for districts to adjust to rapid, unforeseen changes in enrollment, and thus, in the short-run, charter schools might reduce district efficiency. For instance, unforeseen reductions in enrollment might result in underutilization of administrators, facilities, or teachers in certain subjects (Bifulco and Reback 2014). Second, the district might respond to the entry of charter schools by adopting new programming that requires additional expenditures. If these new programs fail to increase student outcomes, then the result will be decreased efficiency.

EMPIRICAL STRATEGY

Our empirical strategy starts with determining treatment and control districts. Then, we utilize difference-in-differences models to estimate the effect of charter school entry on district enrollment and the percentages of students in various need categories. Next, we estimate an expenditure-function that controls for service outcomes, factors related to district costs, and other factors that might influence district efficiency. We include a charter school identifier in these expenditure models to measure how charter schools influence school district efficiency. Finally, using estimates from the same expenditure-function and the difference-in-differences models, we calculate changes in district costs and compare them with the charter school efficiency effects.

Table 1 shows that all districts with a high share of charter school enrollment are located in or adjacent to a district that has a charter school. All these districts have a share of students receiving free lunch of at least 39 percent in 1999/00. No districts with lower shares of free-lunch eligible students reach significant levels of charter school enrollment, even when charter schools are located within the district borders or close-by. Because having charter schools located nearby and having a high share of students in poverty are the primary predictors of charter school enrollment, we define our treatment group as all school districts that have charter schools or that are adjacent to a district with a charter school and that have at least 39 percent of students receiving free lunch during the 1999/00 school year.[1] As a control group, we use all school districts with at least 39 percent share of students receiving free lunch in 1999/00 that neither

[1] In two districts, Utica and Greece, charter schools open in 2013/14. Because we do not observe time periods after charter school opening, we consider these areas control districts.

have a charter within its border nor are adjacent to a district with charter school. Further, we limit the group of control districts to those that have an enrollment greater than 2,000 students because the treated districts are all at least that large.[2]

We begin the analysis by using this sample of treatment and control districts to estimate the effects of charter schools on the key factors related to costs that are likely to be influenced by charter school entry, namely enrollment and student composition. Specifically, we estimate:

$$Y_{dt} = \beta_0 + \beta_1 TREAT_{dt} + \delta_d + \gamma_t + \varepsilon_{dt} \quad (1)$$

where Y_{dt} is either log of enrollment, percentage of free-lunch eligible, percentage of limited English proficient (LEP), or percentage of students with disabilities for district d in year t; $TREAT_{dt}$ is an indicator variable that takes the value of one for treatment group districts in the years after a charter school was first established in the district or an adjacent district, and 0 otherwise; δ_d is a district specific fixed effect, and γ_t represents year fixed effects. The district fixed effects control for district characteristics that do not change over time and the year fixed effects for annual shocks experienced by all districts in our sample.[3] Estimates of β_1 indicate how much more the variable of interest increased or decreased in the treatment districts during the years following the entry of charter schools than in the comparison districts during the same years. The equations are estimated using OLS with robust standards errors clustered by district.

To estimate the effect of changes in enrollment and student composition on districts costs as well as the changes in efficiency associated with charter school entry, we draw on the cost-function literature (Downes and Pogue 1994; Duncombe and Yinger 1998, 2005, 2008, 2011a,

[2] In the regression we estimate, treated districts also serve as controls in years prior to charter school entry.
[3] We also run models using district specific time trends. Compared to models without trends, the coefficients on the charter school variable are of similar magnitude but less precisely estimated.

2011b; Eom et al., 2014; Reschovsky and Imazeki 2001, 2003). Particularly, we estimate the following expenditure equation:

$$\ln(E_{dt}) = \alpha_0 + \alpha_1 TREAT_{dt} + \alpha_2 \ln(S_{dt}) + \alpha_3 \ln(W_{dt}) + \alpha_4 \ln(\boldsymbol{P}_{dt}) \quad (2)$$
$$+ \alpha_5 \ln(N_{dt}) + \alpha_6 [\ln(N_{dt})]^2 + \alpha_7 \ln(\boldsymbol{M}_{dt}) + \mu_d + \eta_t + \upsilon_{dt}$$

where all variables are defined as before, and $\boldsymbol{M}$ is a vector of variables[4] that influence efficiency (discussed below). γ_d and η_t are district and year fixed effects, respectively, and υ_{dt} is an idiosyncratic error term. Similar to prior studies, we include a quadratic term for enrollment to model potential economies of scale (Andrews, Duncombe, and Yinger 2002).

The estimates of α_4 and α_5 together with α_6 in Equation 2 are interpreted as the changes in district costs associated with a change in student composition and student enrollment, respectively. These estimates can be combined with the estimated effects of charter school entry on these cost factors (from Equation 1) to calculate the change in district costs associated with charter school entry. Specifically, the change in district costs are computed as:

$$\%\Delta\ cost\ P_x \approx \frac{\beta_{1P_x}}{\bar{P}_{\boldsymbol{x}}} * 100 * \alpha_4 \quad (3)$$

$$\%\Delta\ cost\ N \approx \beta_{1N} * [\alpha_5 + 2\alpha_6 \ln(\bar{N})] \quad (4)$$

Where $\%\Delta\ cost\ P_x$ is the percentage change in costs associated with a change in the percentage of students in a specific need category x; $\bar{P}_{\boldsymbol{x}}$ denotes the average percentage of students in need category x; $\%\Delta\ cost\ N$ is the percentage change in costs associated with a change in the enrollments; and $\bar{N}$ is average enrollment for treated districts prior to charter school enrollment. The coefficients β_{1P_x} and β_{1N} are the coefficients attached to the treatment variable in Equation

[4] We state vectors in bold letters.

1 using percentages of students in various categories and the log of enrollment as dependent variable, respectively. The total change in district costs are computed as the sum of the changes in costs associated with charter induced changes in percent low-income, percent disable, percent school lunch, and enrollment.

The coefficient on the treatment variable in Equation 2 captures the shift in the amount of expenditures used to achieve a given level of service outcome. Since this model controls for other factors that influence district costs, we interpret this coefficient as the effects of charter schools on district efficiency. This interpretation depends on the assumption that we have controlled for all factors that influence district expenditures and that are correlated with the entry of charter schools. Two aspects of our analysis make this assumption plausible. First, the inclusion of district fixed effects controls for any unobserved factors that have constant effects on the costs or efficiency of a district overtime. Second, we include controls for a range of time varying variables that might influence district efficiency.

Two caveats on our analysis are worth noting. First, in the framework we are using, inefficiency arises when a district uses resources less effectively than current technology allows, or when it spends money on outcomes other than the ones measured and included in our estimation of the expenditure equation. If charter schools cause districts to increase (or decrease) spending to achieve objectives other than the measures of student test scores that we include in our analysis, then that will be reflected as a decrease (or increase) in efficiency in our analysis. Second, if charter schools attract relatively high achieving students away from district schools (controlling for free-lunch eligibility, LEP status, and disability), such that districts are unable to achieve a given level of outcomes without increasing per pupil expenditures, then that will be interpreted as a decrease in district efficiency. Similarly, if charter schools attract relatively low achieving students, districts should be able to achieve a given level of outcomes with lower per pupil expenditure, which we would interpret here as an increase in efficiency. In other words, we cannot determine whether the change in efficiency associated with charter school entry, as we measure it, is the result of improved district programming and operations, or changes in the underlying ability of its students.[5]

DATA, SAMPLE, AND MEASURES

To estimate the effect of charter schools on school district expenditures, we utilize a data set including New York State school districts for the years 1998/99 to 2013/14 assembled from a variety of sources. Similar to prior studies, New York City is excluded because we do not have data necessary to include it in estimates of the cost-function (Eom et al 2014; Duncombe and Yinger 2005). This section explains the variables used in the analysis in more detail. All variables are measured for traditional public schools in a school district. Table 2 provides the summary statistics for the baseline year 1998/99, the only year in the data set without any charter schools. All variables are presented separately for treated and control districts. Differences in means are tested using a t-test.

<Table 2>

Spending Measures

To measure spending, we used the school district operating expenditure measure from the Fiscal Profile Reporting System (FPRS) maintained by the New York State Education

5. It is worth noting that this limitation in interpretation would apply even if charter school entry were randomly assigned to districts.

Department (NYSED). The expenditure measure includes instruction, support services such as transportation, and debt services (principal and interest). We excluded all tuition payments to charter schools from the measure.

Performance Measures

We use performance measures drawn from the New York State school district report cards. These measures are based on standardized tests examining student proficiency in mathematics and English. Starting in 1998-99, this system was used consistently until the 2009-10 school year when NYSED changed the cut scores for proficiency levels. We use a similar approach to Eom et al. (2014) to overcome this inconsistency. Specifically, we calculate adjusted proficiency rates based on cut scores before the change in proficiency levels assuming that the distribution of student test scores follows a normal distribution.[6]

We construct a performance index consisting of the equally weighted average percentage of students reaching proficiency levels in reading and mathematics exams in 4th and 8th grade. Further, we include the percentage of students receiving a Regents Diploma by passing at least five Regents exams and the percentage of students not dropping out of high school. This procedure allows us to include performance information for high school grades while still only needing one instrument for performance (instrument procedures are discussed later). Also, this approach is similar to Eom et al. (2014) and allows us to compare our cost-function results with their findings.

6. Eom, et al. (2014) describe the approach in footnote 24 "To correct the proficiency rates for a change in the cut score, we assume the distribution of student scores in each district follows a normal distribution. We then approximate the cumulative standard normal with: $F\{Z\} = 1/[1 + \exp\{-1.702\ Z\}]$, where $Z = (X - \mu)/\sigma$, X is the test score, and μ and σ are its mean and standard deviation, respectively. The proficiency rate at any given Z is $(1 - F\{Z\})$. Because our data set includes μ for each test in each district, we can use this equation to solve for σ using the observed new cut score, X_{NEW}, and the associated proficiency rate. With this estimate of σ we can then calculate $Z_{OLD} = (X_{OLD} - \mu)/\sigma$, where X_{OLD} is the old cut score. The proficiency rate at the old cut score is $(1 - F\{Z_{OLD}\})$".

Cost-Related Measures

Researchers have long recognized that cost of education depends on many factors outside a school district's control. These factors include the wage environment, student enrollment, and concentration of disadvantaged students among the student population (see Duncombe and Yinger 2008 for an overview). To control for teacher salaries, we include the Comparable Wage Index (CWI) developed by Taylor and Fowler for the National Center for Education Statistics. The CWI is a measure of the systematic, regional variations in the salaries of college graduates who are not educators (Taylor and Fowler 2006).[7] District enrollment counts are also drawn from NYSED Report Cards and represent official counts of students registered in the district as of October 1 of each school year. As in other work on cost-functions, we use the log of student enrollment and the log of enrollment squared to allow for a nonlinear relationship between per pupil expenditures and enrollment (Duncombe and Yinger 2008, 2011b). We also include the percent of students eligible for free or reduced price lunch, students with limited English proficiency, and students with disability, all of which are drawn from the NYSED school district report cards.

Efficiency-Related Measures

Costs are defined as the minimum spending required to provide students an opportunity to reach a given level of student performance. However, the dependent variable in the cost model is actual per pupil spending, and if a district operates inefficiently, actual per pupil spending will exceed the minimum required spending. While it is not possible to measure

7. Comparable wage index values estimated by Lori Taylor using the methods developed for NCES for each district and each year in our sample are available at http://bush.tamu.edu/research/faculty/Taylor_CWI/.

efficiency directly, it is possible to control for it indirectly and thereby to minimize omitted variable bias.

We follow Duncombe and Yinger (2005, 2011a) and apply two techniques to control for efficiency. First, we run specifications including district fixed effects enabling us to control for all district characteristics including efficiency that do not vary over time. Second, we include variables in the cost-function that have been linked to school district efficiency in previous research, but which are themselves unlikely to be influenced by charter school entry. These efficiency related variables include resident income, share of state aid, local tax share, percentage share of residents with college degrees, and the share of youth in the district.

Taxpayers in districts with high resident income and high shares of state aid are less likely to pressure public officials to operate efficiently compared to districts with lower fiscal capacity. They could also be more apt to spend money on non-tested subjects. As our performance measurement only captures improvement in test scores, the additional spending for non-tested subjects potentially decreases school district efficiency. The local tax share is defined as the ratio between the median housing value and the average per pupil housing value in the district. The smaller the ratio, the less the median voter in the district has to pay for an additional unit of education. Therefore, small ratios potentially increase the demand for education, but they are also likely to decrease the incentive to monitor public officials. Demographic factors such as the share of college educated parents and the share of children in the total population have been found to decrease school district efficiency, and hence, we include these demographic factors in the cost models as well. The specific efficiency-related variables included in our analysis and the data sources used to construct those variables are detailed in Table 2

Instruments

School district spending and performance are simultaneous determined by district decision makers. Therefore, similar to Eom et al. (2014), we instrument for performance with exogenous traits of school districts in the rest of the district's county. A district's own choices are likely to be influenced by choices of nearby districts, and the choice of nearby districts are influenced by their exogenous traits. More specifically, we use average percentage of LEP students in the rest of the county as instruments.

RESULTS

Impacts on Cost-Related Factors

Table 3 provides the results for our difference-in differences models measuring the impact of charter schools on cost-related factors. The table includes separate columns for each of the four dependent variables: percentage of the students in poverty, percentage of students with limited English proficiency, percentage of students with disabilities, and the log of student enrollment in the district. The first column for each of the four dependent variables uses a single post period, reaching over the entire time period after charter school opening, as the treatment variable. The second column splits up the post period and reports results for 1-4 and 5–8 years after charter entry allowing us to measure changes in the charter effect over time.[8] The sample includes 14 treated and 14 control districts. All standard errors are clustered at the district level.

<Table 3>

[8] We do not report results for later time periods as we cannot discern between impacts based on the length of the treatment period and the composition of the treated districts. The treatment districts include all of the districts listed in Table 1 that have 39 percent or more students receiving free-lunch in 1999, plus Cohoes, Niagara Falls, and Rensselaer. As noted earlier, Utica and Greece are excluded from the treatment group and considered controls as we do not observe any post-period. Of 14 treatment group districts, 13 are observed for at least 8 post-treatment years.

The estimates for the first specification, using a single post period for the entire time after charter school opening, suggest that there is a positive and statistically significant relationship between charter entry and the share of students receiving free lunch. After charter school entry, a district's share of students receiving free lunch increases by almost 3 percent. There is no evidence that these effects differ with the length of time that districts have been exposed to charter school competition.

The next models use the percentage of LEP students as the dependent variable. The coefficient on the variable using a single post period is negative and statistically significant implying that the share of LEP students is reduced by 2.8 percent after a charter school opening. Again, the effect estimates during the first four years after charter school entry and five to eight years after entry are similar in magnitude and statistically indistinguishable. The result is somewhat surprising as several studies show that charter schools often cream skim and avoid high cost students (Fiske and Ladd 2000; Cobb and Glass 1999; Lee and Croninger 1994; Wells 1993; Ravitch 2010). However, there is also evidence that charter schools target certain groups of students and specialize in educating them (Thernstrom and Therstrom 2003). Charter schools in New York State seem to follow the latter strategy regarding LEP students.

The results for regressing the percentage of students with disabilities on the treatment variable indicate increases in the share of students with disabilities (IEP) associated with charter school entry. The coefficient on the treatment variable is positive and statistically significant at the ten percent level. The magnitude of the estimate suggests that after charter school entry the percentage of students with disabilities in traditional public schools increases by 1.61 percent.

Again, the effect estimates during the first four years and five to eight years after are similar in magnitude and statistically indistinguishable.

The last two models use the log of school district enrollment as the dependent variable. The coefficient on the first treatment variable is negative and statistically significant. Charter school entry leads to a 7.4 percent decrease in school district enrollment. The estimates measuring the influence of charter schools, for the first four and for five to eight years after charter school opening, are negative and statistically significant as well. The second coefficient is 2.73 percentage points greater than the first estimate indicating a larger influence of charter schools on enrollment over time.

Estimated Effects on Costs

The first stage of our expenditure analysis, which is used to address the endogeneity of student performance measures in the expenditure function, uses the average percentage of LEP students in the rest of the county as instrument for performance. In line with Eom et al. (2014), the coefficient on the instrument is positive and statistically significant at the one percent level.

Table 4 shows the second stage results for our expenditure function. The effects of the key control variables in the model—the performance index, the comparable wage index, and the factors related to efficiency[9]—all have the expected signs and many are statistically significant. They are also comparable in magnitude and level of statistical significance to the estimates obtained by Eom et al. (2014), which use a much larger sample of New York State school districts.

[9] In Eom et al. (2014), the adjusted aid ratio term is greater than our state aid term. We use logs and calculate the variable as a ratio between state aid and total revenues. Thus, our coefficients have to be smaller.

As anticipated, the coefficients on the variables measuring percentages of disadvantaged students are positive. Increasing the share of students with disabilities by one percentage point is associated with a 0.025 percent increase in per pupil expenditures in the district, a one percentage point increase in the share of LEP students leads to a 0.002 percent increase in per pupil expenditures, and a one percentage point increase in the share of free-lunch eligible students is associated with a 0.010 percent increase in per pupil expenditures. Although none of these estimated effects is statistically distinguishable from zero, they are similar in magnitude to estimates obtained from other cost studies that use a much larger sample of New York districts and therefore obtain more precise estimates (Eom et al 2014; Duncombe and Yinger 2011). The estimated effects of these cost related variables are similar in the model that differentiates between different post periods, however, the coefficient on the disability variable is statistically significant at the five percent level in the second model. Enrollment increases are associated with decreases in costs. Given the coefficients in the first model, an increase in enrollment by one percent leads to a decrease in per pupil spending by 0.4 percent for the average sized treatment districts.

<Table 4>

To assess the magnitude of charter schools on the costs of providing education in traditional public schools we use Equations 3 and 4 and the corresponding results in Table 3 and 4. Charter schools increase the per pupil expenditure to reach a given level of performance by 3.16 percent using estimates based on a single time period after charter school entry. Breaking down the post period, we find that charter schools increase the cost of providing education by 2.5 and by 3.45 percent in years 1-4 and 5-8 respectively. It should be noted, however, that the charter effect on cost-related factors, particularly for the estimation with multiple post periods, as well as the impact of these factors on minimum costs are estimated with considerable error. As a consequence, our cost calculations also have wide confidence intervals.

Impacts on Efficiency

The estimate of the coefficient on the treatment variable in the expenditure function is negative and statistically significant suggesting a 3.09 percent reduction of per pupil operating expenditures required to achieve a given level of outcomes after charter school entry. This result implies that charter school entry is associated with an increase in district efficiency. The results also suggest that efficiency increases the longer a district has been exposed to charter school competition. Specifically, the estimates in the second column of Table 4 imply that efficiency increases 3.29 percent over the first four years following charter school entry and 6.99 percent five to eight years after charter school entry.

Net Impacts

That charter school entry is associated with decreases in spending, after controlling for measures of student performance, cost factors and other factors that influence efficiency, suggests that charter school entry is associated with increase in efficiency. If we consider both the estimated increases in district costs over the entire post-treatment period of 3.16 percent, along with the estimated increases in efficiency of 3.09 percent, per pupil spending for a given performance standard increases by 0.07 percent. Thus, cost increases appear to offset efficiency gains completely. The estimated net effect of charter schools also appear to change over time. The results from the model that allows the effects of charter school to differ one to four years and five to eight years after entry imply decreases in per pupil expenditure of 0.79 percent in the first four years and of 3.54 percent during years 5 to 8. The difference in the magnitude of the net effects between the two specifications is mainly driven by the much larger charter effect on efficiency in later time periods. Thus, although cost increases and efficiency gains appear to offset each other during the first years immediately following charter school entry, over the long run, as efficiency gains grow, the spending used to achieve given levels of outcomes decreases.

CONCLUSIONS

Our conceptual model, based on the cost function approach, suggests that charter schools can influence the amount of spending used to achieve student outcomes in traditional school districts by changing the cost and efficiency of educating students. Costs are altered if charter schools change the composition and number of students in traditional school districts. Efficiency can increase if traditional schools react to charter competition by improving services or by reallocating resources from less to more productive uses. Decreases in efficiency can be a result of unforeseen reductions in enrollment leading to underutilization of administrators and teachers or increased spending for new programs that do not lead to increases in students' performance.

Our empirical analysis shows that charter schools in New York State have increased the cost of providing education in traditional school districts by decreasing student enrollment and increasing the number of poor and disabled students. They have reduced costs by decreasing the number of students with limited English proficiency. The net of these effect increases the costs of providing education for traditional schools, although we caution that these estimates have a large confidence interval around them. Additionally, we provide evidence that charter schools in New York State are associated with increased district efficiency. Comparing cost and efficiency impacts, cost increase and efficiency gains roughly offset each other in the first years after charter school entry, but efficiency gains outweigh cost increases five to eight years after charter entry.

Our findings have important implications for policy makers and the public finance literature. First, our study is the first to combine cost function and program evaluation literature to study the effect of charter schools on spending in traditional public schools. Second, our study establishes, theoretically and empirically, that charter schools can influence the cost and efficiency of providing education and that both of these factors have to be considered in estimating the net effect of charters on spending in traditional public schools. Third, we provide evidence that charter schools increase costs and the efficiency of school districts in New York. Our results also suggest that in the long run the efficiency gains are greater than the cost increases.

Our findings come with two caveats, however. First, education is characterized by the joint production of multiple outputs, and our estimates of the effect of charter schools on district efficiency only control for a limited set of those outcomes. Thus, the increase in efficiency we estimate could reflect either the more efficient use of resources to educate students or reductions in spending for outcomes other than those for which we control. Second, even after controlling for the measures of student need that we include in our cost function, transfers to charter schools can leave district schools with students that have different underlying abilities to achieve educational objectives. We cannot determine whether the change in efficiency associated with charter school entry, as we measure it, is the result of improved district programming and operations, or changes in the underlying ability of its students.

Although there are these limits to our approach to measuring the effects of charter schools on districts costs and efficiency, it has the benefits of providing conceptual clarity and a framework for assessing the potentially countervailing effects of charter schools. Thus, we believe it would be useful to replicate this study for other states. More specifically, the efficiency gains presented in this study are likely to be associated with specific program features in New York State. Particularly, the application and monitoring processes New York State charter authorizers use has been ranked among the most comprehensive in the nation. Furthermore, almost all charter schools in New York State are non-profit organizations focusing on education related missions and not profit maximization. These program features are likely to determine how charter schools influence efficiency in traditional schools and thus our findings may only apply to states with similar charter policies. Application of our approach to districts in a broader set of states with a variety of charter school policies can help advance our understanding of charter school effects of traditional public school districts.

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TABLE 1
Charter School Location in New York State Outside of New York City

District	First Charter Established	Number of Charter Schools in 2013/14	Percentage of Charter Enrollment in 2013/14	Percentage of Charter Students Outside District	Percentage of Student in District Receiving Free Lunch in 1999	Highest Percentage of Charter School Student in Adjacent District	Percentage of Students Receiving Free Lunch in Adjacent District
Albany	1999/00	11	21.71	22.15	51.48	5.41	42.67
Buffalo	2000/01	15	20.05	4.59	66.47	24.33	62.02
East Irondequoit[1]	2011/12	0	0.01	N/A	12.50	10.34	70.96
Greece	2013/14	1	0.01	97.29	11.95	10.34	70.96
Hempstead	2000/01	2	10.54	25.87	53.39	2.41	24.74
Ithaca	2009/10	1	1.17	59.33	19.09	1.61	19.88
Kenmore-Tonawanda	2001/02	1	2.53	88.72	14.89	20.05	66.47
Lackawanna	2001/02	1	24.3	42.24	62.02	20.05	66.47
Mohonasen[2]	2005/06	0	0	N/A	N/A	21.71	51.48
Mount Vernon	2011/12	1	3.1	1.25	42.45	2.03	62.12
Newburgh	2013/14	1	0.48	8.47	43.16	0.01	4.58
Niagara Wheatfield	2006/07	1	0.24	97.48	14.21	5.23	42.70
Riverhead	2000/01	1	2.6	53.2	25.81	0.7	0.00
Rochester	2001/02	9	10.34	3.49	70.96	0.45	3.04
Roosevelt	2000/01	1	8.82	55.43	53.06	2.44	24.74
Schenectady[3]	2000/01	0	1.7	N/A	49.27	0.01	7.98
Syracuse	2000/01	2	6.05	6.36	56.20	0.01	20.78
Troy	2001/02	2	18.68	12.91	39.39	5.4	12.45
Utica	2013/14	1	1.76	4.47	59.57	0.19	21.13
Yonkers	2005/06	1	2.03	3.72	62.12	3.1	42.45

Sources: Table based on information from the Basic Educational Data System (BEDS) and SUNY charter school institute.

1. Charter school closed in 2012/13

2. Charter school closed in 2008/09.

3. Charter school closed in 2004/05

TABLE 2
Summary Statistics for Treated and Control Districts

	Treated Districts		Control Districts		
	Mean	Standard Deviation	Mean	Standard Deviation	Mean Difference
District Count	14		14		
Operating expenditures[1]	16,384	1,667	16,499	3,423	-114
Performance Index[1] (Mean of % proficient, % earning diploma, and % non-dropout)	46.02	6.51	49.52	9.12	-3.5
Cost Related Variables					
Comparable wage index[2]	1.02	0.12	1.00	0.13	0.02
Enrollment[1]	13,318	13,758	5,269	3,796	8,048*
Percent of students with disabilities[1]	14.37	5.12	13.75	2.78	0.62
Percent LEP students[1]	5.98	5.08	7.76	5.8	-1.78
Percent free lunch[1]	55.06	8.78	52.16	11.29	2.9
Efficiency Variable					
Local tax share[1,3,4]	0.54	0.22	0.50	0.19	0.04
Share of state aid [1]	.05	0.1	0.05	0.1	0
Income per pupil[1]	100,197	26,151	97,647	31,937	2,549
Percent college graduates[3,4]	19.46	5.78	16.40	4.23	3.06
Percent youth (age 5 -17)[3,4]	28.22	2.19	29.08	3.85	-0.86
Instrumental Variable					
Average percent of LEP students in the county (excluding focal district) [1,5]	2.27	24.34	2.13	.56	0.14

Notes: Summary measurements are for the year 1998/99, the only year in the data set without charter schools for all treated districts. Variables including the STAR tax share are not available for 1998/99 as the program was implemented in 1999/00. All monetary values are adjusted for inflation and displayed in 2014 dollars. Differences in means are tested using a t-test: *** p < 0.01; ** p < 0.05; * p < 0.1.
Sources:
(1) From New York State Education Department.
(2) From National Center for Education Statistics.
(3) From American Community Survey
(4) From U.S. Census (the annual values for inter-census years between 1999 and 2009 were interpolated by using the linear growth rate between 1999 and 2009).
(5) From U.S. Census, Count Business Patterns

TABLE 3
Effects of Charter School Entry on Cost-Related Variables

	Percentage Free Lunch		Percentage LEP		Percentage IEP		Log Enrollment	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Treatment								
Treatment × Post	2.956*		-2.821**		1.608*		-0.0744***	
	(1.540)		(1.057)		(0.937)		(0.0253)	
Treatment × Years 1, 2, 3, and 4 Post		3.137		-2.569***		1.519		-0.0616***
		(2.705)		(0.762)		(0.930)		(0.0205)
Treatment × Years 5, 6, 7, and 8 Post		2.629		-2.856*		1.484		-0.0889**
		(1.847)		(1.565)		(1.573)		(0.0349)
Other								
Constant	53.07***	53.00***	6.431***	6.479***	13.89***	13.87***	8.675***	8.674***
	(1.050)	(1.062)	(0.729)	(0.724)	(0.701)	(0.665)	(0.0176)	(0.0176)
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	448	448	448	448	448	448	448	448
Number of census	28	28	28	28	28	28	28	28
R-squared	0.363	0.368	0.380	0.394	0.158	0.159	0.383	0.412

Robust standard errors in parenthesis: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

TABLE 4
Estimates of Expenditure Functions

	Log of per pupil operating expenditure excl. charter tuition	
	(1)	**(2)**
Treatment X Post	-0.0309**	
	(0.0152)	
Treatment X Years 1, 2, 3, and 4 Post		-0.0329***
		(0.0106)
Treatment X Years 5, 6, 7, and 8 Post		-0.0699***
		(0.0127)
Performance Index	0.146	0.1432
	(0.273)	(0.231)
Comparable wage index	0.301	0.427**
	(0.188)	(0.186)
Enrollment[a]	-0.302	-0.181
	(0.351)	(0.301)
Enrollment squared[a]	-0.0106	-0.0214
	(0.0195)	(0.0170)
Percent of students with disabilities[a]	0.0250	0.0301**
	(0.0161)	(0.0147)
Percent LEP students[a]	0.00153	0.00173
	(0.0117)	(0.00794)
Percent free lunch[a]	0.00996	0.00946
	(0.0138)	(0.00880)
Local tax share[a]	-0.245***	-0.253***
	(0.0734)	(0.0616)
State aid term[a]	0.180***	0.209***
	(0.0492)	(0.0370)
Income per pupil[a]	0.175***	0.211***
	(0.0449)	(0.0331)
Percent college graduates	-0.176*	-0.178*
	(0.105)	(0.0970)
Percent youth (age 5 - 17)	-0.0580	-0.0753
	(0.206)	(0.177)
Observations	**448**	**448**
R-squared	**0.894**	**0.912**
Number of districts	**28**	**28**

Notes: All independent variables other than the treatment variables are entered in logs. Robust standard errors in parenthesis: *** p<0.01; ** p<0.05; * p<0.1. Regression is estimated instrumenting for performance. Robust standard errors are clustered at the district level. [a] Variable is log transformed