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The cost-effectiveness of public charter schools in Texas

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Abstract

I compare per pupil revenues, expenditures, and performance levels in public charter schools to district-run public schools in Texas for the 2017-18 school year. After controlling for several school and student characteristics, I find that public charter schools are funded around $1,700 (15 percent) less, and spend around $3,700 (28 percent) less, per pupil than district-run public schools. Public charter schools demonstrate cost-effectiveness advantages between 8 and 42 percent, depending on the model employed, over district-run public schools in Texas. I also find evidence to suggest per pupil spending is positively related to state testing outcomes for public charter schools, but not for district-run public schools.

Keywords: charter schools; school choice; economics of education; school productivity; education spending

JEL Codes: I28; I20

Introduction

The United States spent over $675 billion on public education in the 2015-16 school year.[1] While inflation-adjusted per pupil spending has nearly quadrupled in the last half century (Hanushek & Lindseth, 2009), challenges such as underfunded pension liabilities could pressure policymakers to economize in the future (Hess & Squire, 2010; Koedel, Podgursky, & Shi 2013). Because public education resources are scarce, policymakers may want to know whether particular school sectors are more efficient than others.

Public charter schools, which are independently run public schools, could be more or less cost-effective than district-run public schools. In general, public charter schools must accept all students and use random-based admissions processes in the case of oversubscription.[2] In 2019, 45 states and the District of Columbia allowed public charter schools.[3] Over 7,000 public charter schools served nearly 3.2 million students in the 2017-18 school year in the United States. The Texas law allowing public charter schools to operate was enacted in 1995, four years after the first U.S. charter school law passed in 1991 in Minnesota (Fusarelli, 1999; Vergari, 1999). It is estimated that about 774 public charter schools served around 337,100 students in the 2017-18 school year in Texas.[4]

In theory, public charter schools might be more cost-effective than district-run public schools because of competitive pressures, freedom from government regulations (Shakeel &

[1] Revenues and Expenditures for Public Elementary and Secondary Education: School Year 2015–16 (Fiscal Year 2016). National Center for Education Statistics. Retrieved from https://nces.ed.gov/pubs2019/2019301.pdf
[2] What is a charter school? National Charter School Resource Center at Safal Partners. U.S. Department of Education. Retrieved from https://charterschoolcenter.ed.gov/what-is-a-charter-school
[3] West Virginia education bill passes, allowing charter schools. FOX WTOV9. Retrieved from https://wtov9.com/news/local/west-virginia-education-bill-passes-allowing-charter-schools; Charter schools: Does the state have a charter school law? Education Commission of the States. Retrieved from http://ecs.force.com/mbdata/mbquestNB2C?rep=CS1701
[4] Estimated Public Charter School Enrollment 2017-18. National Alliance for Public Charter Schools. Retrieved from https://www.publiccharters.org/our-work/publications/estimated-public-charter-school-enrollment-2017-18

DeAngelis, 2017), and an improved match between educators and students (DeAngelis & Holmes Erickson, 2018). Economists would argue that district-run public schools exercise monopoly power because of residential assignment and funding through property taxes (Friedman, 1955). Public charter schools reduce the transaction costs associated with switching schools (Hanushek et al., 2007) and hold less monopoly power because they are expected to attract their customers (Hoxby, 2007). More power in the hands of families should lead to stronger incentives to perform well and spend scarce education dollars wisely in public charter schools. Public charter schools might also need to spend education dollars more efficiently if the school funding formula systematically funds them at lower levels.

However, it is possible for public charter schools to underperform relative to district-run public schools if families do not choose schools that better fit their children (Abdulkadiroğlu, Pathak, & Walters, 2018; Harris, 2017).[5] Families might also value school traits that are not captured by state tests, such as safety, culture, brand, and specialized mission (e.g. Abdulkadiroğlu et al., 2017; Bedrick & Burke, 2018; Beuermann & Jackson, 2018; Cheng, Trivitt, & Wolf, 2016; Holmes Erickson, 2017; Kelly & Scafidi, 2013; Trivitt & Wolf, 2016). Public charter schools also might spend education dollars less efficiently than district-run public schools if they are heavily focused on advertising rather than improving learning (Lubienski, 2007). This study tests the three following research hypotheses:

H1: Public charter schools have lower expenditures and revenues per pupil than district-run public schools.

[5] A new study reveals much about how parents really choose schools. NPR. Retrieved from https://www.npr.org/sections/ed/2015/01/15/376966406/a-new-study-reveals-much-about-how-parents-really-choose-schools

H2: Public charter schools are more cost-effective than district-run public schools (as measured by proficiency on the state test divided by per pupil revenues and expenditures).

H3: A stronger positive relationship between per pupil revenues (and expenditures) and state test proficiency exists for public charter schools than district-run public schools.

After controlling for several school and student characteristics, I find that public charter schools are funded around $1,700 (15 percent) less, and spend around $3,700 (28 percent) less, per pupil than district-run public schools in Texas. Public charter schools demonstrate cost-effectiveness advantages between 8 and 42 percent, depending on the model employed, over district-run public schools in Texas in 2017-18. I also find evidence to suggest per pupil spending is positively related to state testing outcomes for public charter schools, but not for district-run public schools.

The next section is a review of the evidence on public charter school funding inequities, public charter school productivity, and the relationship between school spending and educational outcomes. Then the data used and methods employed are discussed. Results from the analytic models are presented, followed by a discussion of their limitations and implications.

Literature Review

This section reviews the literature on funding inequities between public charter and district-run public school sectors in the U.S. Studies on the productivity of public charter schools are also reviewed. Finally, literature on the relationship between education spending and outcomes is reviewed.

Public Charter School Productivity

Seven existing studies have specifically examined funding inequities between public charter and district-run public school sectors in the U.S. (Batdorff et al., 2005; Batdorff et al., 2010; Batdorff et al., 2014; DeAngelis & DeGrow, 2018; DeAngelis et al., 2018b; DeAngelis, 2019a; Wolf et al., 2017). The first evaluation comparing per pupil funding between the two sectors found that public charter schools received about 22 percent less than district-run public schools across 16 states and the District of Columbia (DC) in the 2002-03 school year (Batdorff et al., 2005). The first update to the evaluation found that public charter schools received about 19 percent less in funding that district-run public schools across 23 states and DC in the 2006-07 school year (Batdorff et al., 2010). The third evaluation, including a sample of 30 states and DC, found that the funding gap favoring district-run public schools grew to about 28 percent in the 2010-11 school year (Batdorff et al., 2014). The four other evaluations calculated funding differences between sectors at the city level, each finding funding gaps favoring district-run public schools at or above 20 percent (DeAngelis & DeGrow, 2018; DeAngelis et al., 2018b; DeAngelis, 2019a; Wolf et al., 2017).

Cost-Effectiveness is "the efficacy of a program in achieving given intervention outcomes in relation to the program costs" (Rossi, Lipsey, & Freeman, 2003). Several studies have specifically examined differences in cost-effectiveness between public charter and district-run public school sectors (DeAngelis, 2019a; DeAngelis & DeGrow, 2018; DeAngelis et al., 2018a; DeAngelis et al., 2019; Flanders, 2017; Wolf et al., 2014). These studies tend to find that public charter schools are more cost-effective, in terms of standardized test scores produced per dollar spent, than nearby district-run public schools. However, few existing studies are able to control for differences in student background characteristics (DeAngelis & DeGrow, 2018;

Flanders, 2017). DeAngelis and DeGrow (2018) found that public charter schools were 32 percent more cost-effective than district-run public schools using data from 71 cities in Michigan during the 2014-15 school year. Flanders (2017) found a 33 percent and a 42 percent cost-effectiveness advantage for independent charter schools in science and math, respectively, in Milwaukee in 2014-15.

Several existing evaluations of public charter school performance relative to district-run public schools in Texas do not to account for differences in per pupil spending (e.g. Baude et al., 2019; Booker et al., 2007; CREDO, 2015; Hanushek et al., 2007). However, at least four studies have found efficiency advantages of public charter schools in Texas (Gronberg & Jansen, 2001; Gronberg, Jansen, & Taylor, 2012; Gronberg, Jansen, & Taylor, 2016; Grosskopf, Hayes, & Taylor, 2009). The most recent data examined by any of the four evaluations were from 2011 (Gronberg, Jansen, & Taylor, 2016). The current study adds to the literature since it uses per pupil revenue and expenditure data from the 2017-18 school year and compares funding inequity and cost-effectiveness between public charter and district-run public schools in Texas. This study also uses more control variables than recent evaluations, which account for observable differences in students between public school sectors (e.g. DeAngelis & DeGrow, 2018; Flanders, 2017).

Spending and Outcomes

In theory, the public charter school cost-effectiveness advantages could exist because public charter schools have stronger competitive pressures to spend scarce education dollars wisely (Friedman, 1955; Hoxby, 2007). If district-run public schools have weak incentives to spend money wisely, we would expect increases in education funding to have little or no effect on student outcomes. Several studies have attempted to determine whether increases in funding lead

to improved academic outcomes in the public school sector. Hanushek (1997) reviewed nearly 400 studies on the topic and found that "there is not a strong or consistent relationship between student performance and school resources."

A review of the more recent research, focusing on 33 quasi-experimental evaluations, found that increases in funding are generally positively associated with student outcomes (Jackson, 2018). Twenty-six of the 33 reviewed studies found statistically significant positive effects (e.g. Hyman, 2017; Jackson, Johnson, & Persico, 2015; Lafortune, Rothstein, & Schanzenbach, 2018), while the remaining 8 evaluations found no effects overall (e.g. Cellini, Ferreira, & Rothstein, 2010; Hoxby, 2001; Martorell, Stange, & McFarlin, 2016). For example, Jackson, Johnson, and Persico (2015) used court-ordered spending reforms as an instrumental variable and found that a 10 percent increase in per pupil spending each year for 12 years is associated with 0.31 more completed years of education and 7 percent higher wages. Lafortune, Rothstein, and Schanzenbach (2018) similarly found that spending increases in low-income school districts were associated with large increases in student test scores.

Jackson (2018) concluded that "researchers should now focus on understanding what kinds of spending increases matter the most." While several studies have examined the relationship between spending and outcomes in traditional public schools, no evaluations have looked at this relationship between sectors. In other words, while several studies have questioned "does money matter?" none have asked "where does money matter the most?" This study begins to address this question by comparing funding and outcomes between public school sectors in Texas.

Data

School- and district-level data from the 2017-18 school year were provided by the Texas Education Agency (TEA). Total expenditures per pupil were provided by TEA in response to Public Information Request[6] number 38275.[7] Campus-level student demographic information (gender, race/ethnicity, Gifted and Talented, Career and Technical Education, Limited English Proficiency, English as a Second Language, economically disadvantaged, Title 1, and special needs), school level, and total enrollment were found at the TEA website.[8] Campus-level data on overall student test score performance were also found at the TEA website.[9] Student performance was measured by the State of Texas Assessments of Academic Readiness (STAAR). Other descriptive campus-level data (city and campus type) were also found at the TEA website.[10]

Schools missing data on any student demographics, enrollment, school level, and campus type were removed from the analysis. The analytic sample includes 5,472 schools in Texas, 432 of which are public charter schools (8 percent of the sample). On average, 49 percent of students in the sample identify as Hispanic or Latino, 14 percent identify as black or African American, and 30 percent identify as white (Table 1). About 10 percent of students are identified as having learning disabilities (SPED), 61 percent are economically disadvantaged, 72 percent qualify for Title 1, 9 percent are classified as English as a Second Language (ESL), 19 percent have Limited

[6] Public Information Requests can be made at https://tealprod.tea.state.tx.us/Pirts/Public/NewPendingPIR.aspx
[7] Interest and sinking (I&S) dollars are excluded from the analysis since they are recorded and paid at the district-level, while the current analysis uses school-level data. The exclusion of I&S dollars makes any public charter school funding disadvantages and productivity advantages found in this study conservative because public charter schools generally do not receive any local I&S dollars in Texas.
[8] *Student Program and Special Populations Reports*. Texas Education Agency. Retrieved from https://rptsvr1.tea.texas.gov/adhocrpt/adspr.html. *Student Enrollment Reports*. Texas Education Agency. Retrieved from https://rptsvr1.tea.texas.gov/adhocrpt/adste.html
[9] *2018 Data Download*. 2018 Accountability Ratings. Texas Education Agency. Retrieved from https://rptsvr1.tea.texas.gov/perfreport/account/2018/download.html
[10] *Download File. Texas Education Directory*. Texas Education Agency. Retrieved from http://tea4avholly.tea.state.tx.us/TEA.AskTED.Web/Forms/DownloadFile.aspx

English Proficiency (LEP), and 7 percent are in the Gifted and Talented (GT) program. Forty-six percent of students in grades 3 through 12 are classified as "meets grade level or above" and 21 percent are classified as "masters grade level" across all STAAR subjects.

Table 1: Descriptive Statistics

	Mean	Standard Deviation	Minimum	Maximum
School Level				
Elementary	0.57	0.49	0.00	1.00
Elementary/Secondary	0.05	0.22	0.00	1.00
Junior High	0.03	0.18	0.00	1.00
Middle	0.18	0.38	0.00	1.00
High	0.16	0.37	0.00	1.00
Campus Type				
Instructional Campus	0.97	0.16	0.00	1.00
Alternative Instructional Unit	0.02	0.15	0.00	1.00
DAEP-Only Campus	0.00	0.04	0.00	1.00
Juvenile Justice Program	0.00	0.02	0.00	1.00
Other School Characteristics				
Charter	0.08	0.26	0.00	1.00
Enrollment (100s)	7.49	5.67	0.00	59.31
Student Demographics			0.00	1.00
Black or African American (%)	13.86	14.96	0.00	96.18
Hispanic or Latino (%)	49.33	26.45	0.00	1.00
White (%)	29.75	24.00	0.00	94.22
Female (%)	48.56	4.03	0.00	1.00
Special Education (SPED) (%)	9.79	4.82	0.00	1.00
Economically Disadvantaged (Econ) (%)	60.75	25.30	0.00	1.00
Title 1 (%)	72.48	44.09	0.00	1.00
English as a Second Language (ESL) (%)	9.35	10.22	0.00	1.00
Limited English Proficiency (LEP) (%)	19.29	18.52	0.00	1.00
Gifted and Talented (GT) (%)	7.04	6.65	0.00	1.00
Career and Technical Education (CTE) (%)	17.62	30.34	0.00	1.00
Outcomes				
School-Level Per Pupil Expenditures ($1,000s)	7.78	2.44	0.00	77.99
District-Level Per Pupil Expenditures ($1,000s)	13.03	2.95	6.43	56.01
District-Level Per Pupil Revenues ($1,000s)	11.80	1.70	6.23	48.95
Meets Grade Level or Above (%)	46.43	14.99	9.00	99.00
Masters Grade Level (%)	20.84	11.16	1.00	79.00
Meets Grade Level Per $1,000 Expenditures	3.69	1.35	0.47	10.44
Meets Grade Level Per $1,000 Revenues	4.00	1.37	0.62	10.46
Masters Grade Level Per $1,000 Expenditures	1.65	0.91	0.07	6.60
Masters Grade Level Per $1,000 Revenues	1.80	0.98	0.08	6.86

Notes: Sample size is 5,472 for all variables except for the last six outcomes. Sample size is 5,217 for "Meets Grade Level or Above" and "Meets Grade Level." Sample size is 5,167 for the last four outcomes. "DAEP" is "Disciplinary Alternative Education Program."

Methods

To evaluate per pupil revenue and expenditure differences between sectors, I employ an ordinary least squares regression of the form:

$$Funding_i = \beta_0 + \beta_1 Charter_i + X_i + \varepsilon_i$$

Where *Funding* is the total per pupil expenditures for each school, *i*, in the 2017-18 school year. Results from models using per pupil revenues are also reported. The independent variable of interest, *Charter*, takes on the value of one if the observation is a public charter school and zero otherwise. Nonpublic schools are excluded from each analysis. X is a vector of controls including total enrollment, school level (elementary, elementary/secondary, junior high, middle, high), campus type (instructional campus, alternative educational unit, DAEP-only campus, juvenile justice program), and the proportions of students in the school who are identified as: black or African American, Hispanic or Latino, white, female, special needs (SPED), economically disadvantaged (Econ), English as a Second Language (ESL), Limited English Proficiency (LEP), Title 1, Gifted and Talented (GT), and Career and Technical Education (CTE). Each school observation is weighted by total enrollment. ε_i is the random error term.

Importantly, interest and sinking (I&S) dollars are excluded from school-level funding data since they are recorded and paid at the district level. The exclusion of I&S dollars makes any public charter school funding disadvantages and productivity advantages found using school-level expenditure conservative because public charter schools generally do not receive any local I&S dollars in Texas. District-run public schools received about $1,200 local I&S dollars per pupil in 2018.[11] Because the school-level funding data exclude a substantial amount

[11] Do Texas charter schools get more money than ISD schools? Texas Charter Schools Association. Retrieved from https://www.txcharterschools.org/wp-content/uploads/2018/11/4_Charters_ISDs_Funding.pdf; Statewide Summary of Finances, 2017-18. Texas Education Agency. Retrieved from https://tealprod.tea.state.tx.us/fsp/Reports/ReportSelection.aspx

of dollars, this study uses district-level expenditures and revenues per pupil. However, results from models using school-level expenditures are included in the Appendix.

To examine the relationship between school sector and outcomes, I employ an ordinary least squares regression of the form:

$$Cost\text{-}Effectiveness_i = \beta_0 + \beta_1 Charter_i + X_i + \varepsilon_i$$

Where *Cost-Effectiveness* is one of the two cost-effectiveness outcomes for each school, *i*, in the 2017-18 school year. These include the percent of students classified as "meets grade level or above" for all subjects on STAAR divided by total per pupil expenditures[12] and the percent of students classified as "masters grade level" all subjects on STAAR divided by total per pupil expenditures. The independent variable of interest, *Charter*, takes on the value of one if the observation is a public charter school and zero otherwise. Nonpublic schools are excluded from each analysis. Vector X includes the same controls as above. ε_i is the random error term.

Differences in per pupil funding and student outcomes can be partially explained by differences in student populations between sectors. However, the direction of selection bias, if any exists, is unclear. In theory, the most advantaged and motivated parents could be the most likely to send their children to public charter schools. On the other hand, if the least advantaged children are residentially assigned to lower quality public schools, then their families would theoretically have stronger incentives to seek educational alternatives. Data from the 2017-18 school year tend to suggest that public charter schools serve a less advantaged population of students than district-run public schools in Texas. Regressions controlling for city, school level, and campus type suggest that public charter schools tend to have higher proportions of students

[12] All public school students take STAAR in grades 3 through 12. STAAR tests are administered in the spring and cover reading, writing, mathematics, science, and social studies. All STAAR assessments have a four-hour time limit except for English I and English II, which both have five-hour time limits. Information retrieved from https://texasassessment.com/families/all-about-the-staar-test/

identified as racial/ethnic minorities, ESL, and Title 1, and lower proportions of students identified as GT (Table 2). However, one statistically significant relationship indicates that district-run public schools have higher proportions of students identified as SPED.

Table 2: Charter School Student Demographics

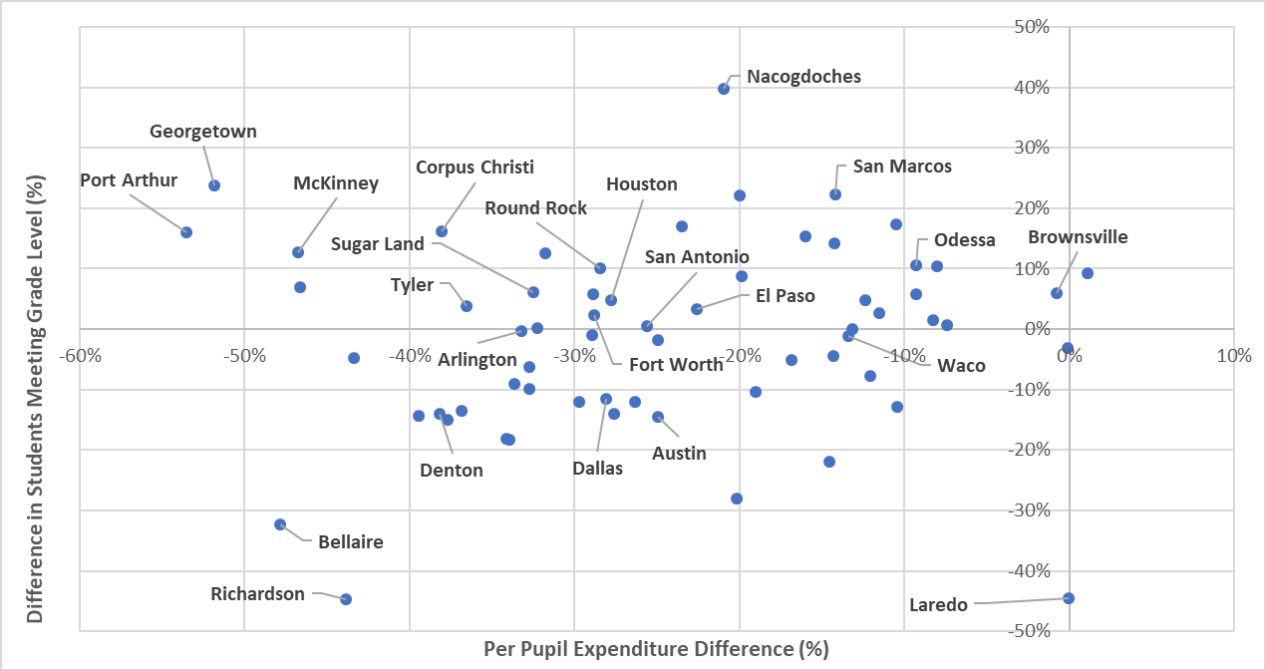
	Black	**Hispanic**	**White**	**SPED**	**Econ**	**Title**	**ESL**	**LEP**	**GT**
Charter	0.031**	-0.009	-0.031+	-0.026***	0.005	0.060+	0.070***	-0.002	-0.051***
	(0.008)	(0.694)	(0.078)	(0.000)	(0.784)	(0.059)	(0.000)	(0.912)	(0.000)
N	5472	5472	5472	5472	5472	5472	5472	5472	5472

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All school-level observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects relative to district-run schools. All models control for city, school level, and campus type. Each dependent variable is expressed as a proportion.

Figure 1 shows the percentage difference in per pupil expenditures for public charter schools relative to district-run public schools (x-axis) and the percentage point difference in the proportion of students meeting grade level or above for public charter schools relative to district-run public schools (y-axis). Each school-level observation is weighted by student enrollment and each point on the chart represents a Texas city with funding and outcome data for both school sectors. About half of the cities (32) are located above the x-axis, about half of the cities are located below the x-axis (30), and one city is located on the x-axis, indicating that public charter schools perform about the same as district-run public schools in Texas overall. Nearly all of the cities are to the left of the y-axis, indicating that public charter schools spend fewer dollars per pupil than district-run public schools. However, Figure 1 does not account for differences in student backgrounds between school sectors. Houston, for example, spent 28 percent less per pupil while achieving higher levels of performance than district-run public schools in 2017-18, but it is possible that Houston charter schools enroll a more advantaged student population than

district-run public schools. Laredo public charter schools, for example, have substantially lower achievement levels while spending roughly the same dollars per pupil than district-run public schools. However, the two public charter schools in Laredo in the sample are both alternative schools, whereas none of the district-run public schools in the sample are alternative schools. The next section uses models that control for several observable differences in students and schools between sectors.

Figure 1: Charter School Spending and Performance



Notes: Reported differences are relative to all district-run public schools in each city. The performance metric is the percent of students classified as "meets grade level or above" for all subjects on the State of Texas Assessments of Academic Readiness (STAAR) in 2017-18.

Funding Inequity Results

Each model suggests that public charter schools spend significantly fewer dollars per pupil than district-run public schools in Texas (Table 3). The base model in column one indicates that charter schools spend $3,730 less, or 29 percent less ($3,730 divided by the sample mean of $13,030), per pupil than district-run public schools. Each column adds additional controls to the model. The fully specified model suggests that public charter schools spend $3,686 less, or 28 percent less, than district-run public schools.[13] The consistent results across all six models suggest that differences in students between sectors do not explain much of the spending disparities. The fully specified model based on revenues shows that public charter schools receive $1,719 less, or about 15 percent less, per pupil than district-run public schools (Table 4).[14] This 15 percent funding gap between sectors is consistent with previous reports based on 2018 data.[15] The per pupil expenditure and revenue disparities favoring district-run public schools hold across seven of the eight largest Texas cities (Tables 5 and 6). The gap favoring district-run public schools might be smaller for revenues than expenditures for a few reasons. In 2017-18, district-run public schools could have been more likely than public charter schools to spend funding reserves from previous years. Bond dollars, which are more common for districts than public charter schools, also count as expenditures in the year that they are raised. In

[13] This result is robust to a non-linear model replacing the dependent variable with the natural log of district-level expenditures per pupil (Appendix Table A1). Table A2 suggests that per pupil spending does not differ between sectors when the fully specified model uses school-level expenditures; however, this model understates the expenditure gap favoring district-run public schools because school-level expenditure data exclude I&S funding.
[14] This result is robust to a non-linear model replacing the dependent variable with the natural log of district-level revenues per pupil (Appendix Table A3).
[15] Do Texas charter schools get more money than ISD schools? Texas Charter Schools Association. Retrieved from https://www.txcharterschools.org/wp-content/uploads/2018/11/4_Charters_ISDs_Funding.pdf; Statewide Summary of Finances, 2017-18. Texas Education Agency. Retrieved from https://tealprod.tea.state.tx.us/fsp/Reports/ReportSelection.asp

addition, public charter schools might have stronger financial incentives than district-run public schools to keep expenditures below revenues.

Control variables behave as expected where statistical significance arises. Schools with higher proportions of students identified as SPED, GT, ESL, and economically disadvantaged tend to receive more dollars per pupil (Table 4). Schools with lower enrollments tend to receive and spend more dollars per pupil, perhaps because of higher levels of fixed costs per student and because Texas provides additional funding for districts with no more than 1,600 students (Mudrazija et al., 2019). In addition, per pupil expenditures tend to rise when public schools lose students because less than 100 percent of funding is linked to changes in enrollment (Roza & Edmonds, 2014). Research from Georgetown University's Edunomics Lab shows that 68 percent of state and local education funding is disbursed on the basis of students in Texas.[16]

[16] Student-based allocation: Doling out dollars based on student needs. Edunomics Lab at Georgetown University. Retrieved from https://edunomicslab.org/our-research/student-based-allocations/

Table 3: Per Pupil Expenditures by Sector

	Per Pupil Expend ($1,000s)	**Per Pupil Expend ($1,000s)**	**Per Pupil Expend ($1,000s)**	**Per Pupil Expend ($1,000s)**	**Per Pupil Expend ($1,000s)**	**Per Pupil Expend ($1,000s)**
Charter	-3.730***	-3.696***	-3.747***	-3.740***	-3.730***	-3.686***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Enrollment (100s)	-0.013*	-0.011*	-0.013*	-0.011*	-0.011*	-0.011+
	(0.020)	(0.034)	(0.023)	(0.038)	(0.036)	(0.054)
Black (%)		0.022***	0.024***	0.017**	0.016**	0.017**
		(0.000)	(0.000)	(0.002)	(0.006)	(0.003)
Hispanic (%)		0.022***	0.023***	0.016**	0.015**	0.016**
		(0.000)	(0.000)	(0.001)	(0.003)	(0.002)
White (%)		0.027***	0.028***	0.029***	0.028***	0.029***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female (%)		0.005	0.001	0.002	0.002	0.001
		(0.441)	(0.904)	(0.751)	(0.778)	(0.829)
SPED (%)			-0.019**	-0.021**	-0.021**	-0.018*
			(0.004)	(0.001)	(0.002)	(0.012)
Econ (%)				0.008***	0.008***	0.009***
				(0.001)	(0.001)	(0.000)
Title 1 (%)				0.000	0.000	0.000
				(0.706)	(0.710)	(0.792)
ESL (%)					-0.002	-0.001
					(0.558)	(0.654)
LEP (%)					-0.000	0.000
					(0.877)	(0.995)
GT (%)						0.008*
						(0.041)
CTE (%)						-0.001
						(0.845)
R-Squared	0.8095	0.8123	0.8127	0.8134	0.8134	0.8136
N	5420	5420	5420	5420	5420	5420

Notes: P-values in parentheses. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Student demographics are proportions. Each model controls for city, school level, and campus type.

Table 4: Per Pupil Revenue by Sector

	Per Pupil Revenue ($1,000s)	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**
Charter	-1.790***	-1.777***	-1.760***	-1.758***	-1.778***	-1.719***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Enrollment (100s)	-0.011***	-0.009***	-0.008**	-0.008**	-0.008**	-0.007**
	(0.000)	(0.001)	(0.002)	(0.003)	(0.002)	(0.007)
Black (%)		0.005*	0.004+	0.001	0.002	0.004
		(0.039)	(0.066)	(0.554)	(0.377)	(0.137)
Hispanic (%)		0.006**	0.005**	0.002	0.003	0.004
		(0.004)	(0.007)	(0.301)	(0.178)	(0.102)
White (%)		0.002	0.002	0.002	0.003	0.004
		(0.336)	(0.412)	(0.350)	(0.226)	(0.115)
Female (%)		-0.007	-0.006	-0.005	-0.005	-0.006
		(0.111)	(0.186)	(0.218)	(0.235)	(0.193)
SPED (%)			0.006+	0.005	0.004	0.008*
			(0.075)	(0.126)	(0.224)	(0.025)
Econ (%)				0.003+	0.003+	0.003*
				(0.058)	(0.074)	(0.024)
Title 1 (%)				0.000	0.000	0.000
				(0.349)	(0.424)	(0.665)
ESL (%)					0.003*	0.003*
					(0.032)	(0.014)
LEP (%)					-0.001	-0.000
					(0.562)	(0.959)
GT (%)						0.010***
						(0.000)
CTE (%)						-0.000
						(0.808)
R-Squared	0.8395	0.8420	0.8422	0.8426	0.8428	0.8442
N	5420	5420	5420	5420	5420	5420

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Student demographics are proportions. Each model controls for city, school level, and campus type.

Table 5: Charter School Per Pupil Expenditure Inequities by City

	Houston	San Antonio	Dallas	Austin	Fort Worth	El Paso	Arlington	Corpus Christi
Charter	-3.944*** (0.000)	-3.472*** (0.000)	-2.423*** (0.000)	-4.190*** (0.000)	-4.040*** (0.000)	-2.529 (0.104)	-2.864*** (0.000)	-5.316*** (0.000)
R-Squared	0.4411	0.5250	0.7049	0.5383	0.7428	0.3488	0.9025	0.8623
N	509	309	227	184	171	118	95	57

Notes: P-values in parentheses. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. All observations are weighted by total enrollment. Coefficients are average marginal effects. Student demographics are proportions. Each model includes all controls. Coefficients for *charter* are presented for the eight largest Texas cities based on total population. Each model drops observations from all other cities.

Table 6: Charter School Per Pupil Revenue Inequities by City

	Houston	San Antonio	Dallas	Austin	Fort Worth	El Paso	Arlington	Corpus Christi
Charter	-1.159*** (0.000)	-1.662*** (0.000)	-1.448*** (0.000)	-1.547*** (0.000)	-2.641*** (0.000)	-0.673 (0.202)	-2.185*** (0.000)	-4.674*** (0.000)
R-Squared	0.3136	0.3811	0.6695	0.5083	0.6010	0.3709	0.9699	0.7336
N	509	309	227	184	171	118	95	57

Notes: P-values in parentheses. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. All observations are weighted by total enrollment. Coefficients are average marginal effects. Student demographics are proportions. Each model includes all controls. Coefficients for *charter* are presented for the eight largest Texas cities based on total population. Each model drops observations from all other cities.

Cost-Effectiveness Results

Each model suggests that public charter schools are more cost-effective than district-run public schools in Texas (Table 7). Public charter schools have a 1.3 percentage point higher proportion of students meeting grade level or higher per $1,000 of per pupil expenditures than district-run public schools, representing a 35 percent cost-effectiveness advantage for public charter schools relative to the sample mean. Public charter schools have a 0.7 percentage point higher proportion of students mastering grade level per $1,000 of per pupil expenditures than district-run public schools, representing a 42 percent cost-effectiveness advantage for public charter schools relative to the sample mean. The results from models based on per pupil revenues also suggest public charter schools are more cost-effective than district-run public schools (columns 3 and 4).

Relative to the sample mean, the models based on per pupil revenues find that public charter schools are about 8 percent more cost-effective than district-run public schools based on meeting grade level and about 32 percent more cost-effective than district-run public schools based on mastering grade level.[17]

Control variables behave as expected where statistical significance arises. Schools with higher proportions of students identified as SPED, economically disadvantaged, Title 1, ESL, and CTE tend to demonstrate lower levels of performance on STAAR, while schools with higher proportions of students identified as GT tend to demonstrate higher levels of performance on STAAR. Schools with higher proportions of female students tend to perform better on STAAR, as found in previous studies (e.g. Van Hek, Krayykamp, & Pelzer, 2018; Van Houtte, 2004). Schools with higher total enrollments and higher proportions of students identified as economically disadvantaged, LEP, and CTE experienced less enrollment growth. Overall, total expenditures per pupil are unrelated to STAAR performance.

Results for the eight largest cities in Texas based on population are shown in Table 8. The results tend to suggest that public charter schools are more cost-effective than district-run public schools. All four models detect statistically significant cost-effectiveness advantages for public charter schools in Houston, San Antonio, Fort Worth, and Arlington. Three models detect statistically significant advantages for public charter schools in Austin, and one model detects statistically significant advantages for public charter schools in Corpus Christi. None of the models find that district-run public schools are more cost-effective than public charter schools.

[17] These results are robust to non-linear models replacing the dependent variable with the natural log of cost-effectiveness (Appendix Table A4). Appendix Table A5 suggests that cost-effectiveness does not differ between sectors when school-level expenditures are used in the model; however, the model based on school-level expenditures understates the cost-effectiveness advantage of public charter schools because school-level expenditure data exclude I&S funding.

Table 7: Cost-Effectiveness by Sector

	Meets per $1,000	**Masters per $1,000**	**Meets per $1,000**	**Masters per $1,000**
Charter	1.291***	0.698***	0.313***	0.578***
	(0.000)	(0.000)	(0.000)	(0.000)
Enrollment (100s)	-0.003	-0.000	-0.000	-0.001
	(0.467)	(0.923)	(0.940)	(0.776)
Black (%)	-0.041***	-0.041***	-0.038***	-0.036***
	(0.000)	(0.000)	(0.000)	(0.000)
Hispanic (%)	-0.028***	-0.028***	-0.030***	-0.028***
	(0.000)	(0.000)	(0.000)	(0.000)
White (%)	-0.025***	-0.021***	-0.024***	-0.025***
	(0.000)	(0.000)	(0.000)	(0.000)
Female (%)	0.018***	0.019***	0.004	0.004
	(0.000)	(0.000)	(0.136)	(0.192)
SPED (%)	-0.029***	-0.042***	-0.031***	-0.024***
	(0.000)	(0.000)	(0.000)	(0.000)
Econ (%)	-0.025***	-0.025***	-0.017***	-0.015***
	(0.000)	(0.000)	(0.000)	(0.000)
Title 1 (%)	-0.001*	-0.001**	-0.001***	-0.001***
	(0.018)	(0.007)	(0.000)	(0.000)
ESL (%)	-0.015***	-0.017***	-0.009***	-0.008***
	(0.000)	(0.000)	(0.000)	(0.000)
LEP (%)	0.001	0.001	0.001	0.001
	(0.410)	(0.458)	(0.352)	(0.424)
GT (%)	0.021***	0.025***	0.027***	0.023***
	(0.000)	(0.000)	(0.000)	(0.000)
CTE (%)	-0.003*	-0.003**	-0.002*	-0.001+
	(0.038)	(0.003)	(0.033)	(0.092)
R-Squared	0.7934	0.8240	0.8369	0.8136
N	5167	5167	5167	5167

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Student demographics are proportions. Each model controls for city, school level, and campus type. Columns 1 and 2 are based on total per pupil expenditures. Columns 3 and 4 are based on total per pupil revenues.

Table 8: Charter School Cost-Effectiveness by City

	Meets per $1,000	**Masters per $1,000**	**Meets per $1,000**	**Masters per $1,000**
Houston	1.478***	0.633***	0.731***	0.315**
	(0.000)	(0.000)	(0.000)	(0.002)
San Antonio	1.521***	0.726***	0.936***	0.456**
	(0.000)	(0.000)	(0.000)	(0.005)
Dallas	0.554	0.159	0.127	-0.030
	(0.119)	(0.490)	(0.696)	(0.893)
Austin	1.187***	0.476**	0.451*	0.108
	(0.000)	(0.004)	(0.034)	(0.516)
Fort Worth	1.069**	0.557*	0.716*	0.431+
	(0.003)	(0.019)	(0.043)	(0.077)
El Paso	0.794	0.505	-0.245	-0.040
	(0.233)	(0.218)	(0.734)	(0.930)
Arlington	1.443**	0.876*	1.374**	0.852**
	(0.004)	(0.011)	(0.002)	(0.006)
Corpus Christi	1.798***	0.305	0.443	-0.486
	(0.001)	(0.477)	(0.421)	(0.291)

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. Coefficients are average marginal effects. Student demographics are proportions. Each model includes all controls. Columns 1 and 2 are based on total per pupil expenditures. Columns 3 and 4 are based on total per pupil revenues. Coefficients for *charter* are presented for the eight largest Texas cities based on total population. Each model drops observations from all other cities.

Funding and Outcomes

Table 9 reports results from a model interacting per pupil expenditures with school sector to explore whether increases in spending are associated with improved outcomes. There is a positive and statistically significant relationship between per pupil expenditures and test-based outcomes for public charter schools in Texas. A $1,000 increase in per pupil expenditures in public charter schools is associated with a 3 percentage point increase in the proportion of students meeting grade level (column 1), about a 6.5 percent increase relative to the sample mean. A $1,000 increase in per pupil expenditures in public charter schools is associated with a

1.9 percentage point increase in the proportion of students meeting grade level (column 2), about an 8.9 percent increase relative to the sample mean. Neither of the relationships between per pupil spending and outcomes is statistically significant for district-run public schools at the $p < 0.05$ level.[18]

The same pattern emerges when the models are based on per pupil revenues rather than expenditures (Table 10). A $1,000 increase in per pupil revenues in public charter schools is associated with a 3.7 percentage point increase in the proportion of students meeting grade level (column 1), about a 7.9 percent increase relative to the sample mean. A $1,000 increase in per pupil expenditures in public charter schools is associated with a 2.3 percentage point increase in the proportion of students meeting grade level (column 2), about a 10.8 percent increase relative to the sample mean. Neither of the relationships between per pupil revenues and outcomes is statistically significant. The difference in the coefficients between sectors is statistically significant in all models.[19]

A potential takeaway from these results is that money matters more in public charter schools than district-run public schools, perhaps because they have stronger financial incentives to spend wisely. However, this is not the only explanation. Although each model controls for the percent of students identified as having learning disabilities, data on the severity of specific learning disabilities are not available. It is possible that district-run public schools serve more students with severe learning disabilities than public charter schools. District-run public schools that have students with the most severe disabilities could be receiving the most dollars while achieving the lowest test-based outcomes, which could explain the null to negative relationships.

[18] Table A6 in the Appendix finds similar results using school-level expenditure data.

[19] A model replacing the dependent variables with the natural log of the performance metric finds similar positive results for public charter schools. However, the negative coefficients for district-run public schools become statistically significant (Tables A7 and A8).

Table 9: School Performance and Expenditures by Sector

	Meets (%)	**Masters (%)**
Per Pupil Expenditures (Charter)	3.017***	1.850***
	(0.000)	(0.000)
Per Pupil Expenditures (District)	-0.222+	0.012
	(0.076)	(0.900)
Difference	3.239***	1.839***
	(0.000)	(0.000)
All Controls	Yes	Yes
R-Squared	0.8314	0.8428
N	5167	5167

Notes: P-values in parentheses. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. All observations are weighted by total enrollment. All models include all controls. Coefficients are average marginal effects. The difference is calculated by subtracting the coefficient for district-run public schools from the coefficient for public charter schools.

Table 10: School Performance and Revenues by Sector

	Meets (%)	**Masters (%)**
Per Pupil Revenues (Charter)	3.664***	2.257***
	(0.000)	(0.001)
Per Pupil Revenues (District)	-0.158	0.028
	(0.572)	(0.887)
Difference	3.822***	2.229***
	(0.000)	(0.000)
All Controls	Yes	Yes
R-Squared	0.8327	0.8439
N	5167	5167

Notes: P-values in parentheses. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. All observations are weighted by total enrollment. All models include all controls. Coefficients are average marginal effects. The difference is calculated by subtracting the coefficient for district-run public schools from the coefficient for public charter schools.

Discussion

After controlling for several school and student characteristics, I find that public charter schools are funded around $1,700 (15 percent) less, and spend around $3,700 (28 percent) less, per pupil than district-run public schools. Public charter schools demonstrate cost-effectiveness advantages between 8 and 42 percent, depending on the model employed, over district-run public schools in Texas in 2017-18. I also find evidence to suggest per pupil spending is positively related to state testing outcomes for public charter schools, but not for district-run public schools. In theory, increasing the proportion of student-centered funding in Texas could equalize per pupil revenues between public school sectors and increase schools' financial incentives to become more efficient (Friedman, 1955).

However, readers should also consider the study's limitations. Although the analytic models control for several observable differences between school sectors, they are unable to capture all differences in students. For example, controlling for the proportion of students identified as SPED does not account for any variation within the indicator variable. If public charter schools are less likely than district-run public schools to serve students with the most severe disabilities, then the results could overstate any expenditure disparities favoring district-run public schools and performance advantages favoring public charter schools. Similarly, if public charter schools are more likely than district-run public schools to serve the students with the most economic disadvantage, then the results could understate any performance advantages favoring public charter schools. Additionally, although several controls are included to account for observable differences in students between sectors, nonexperimental studies cannot control for differences in unobservable characteristics such as motivation. Another limitation is that the cost-effectiveness results are based on students' performance on standardized assessments,

which may not be strong proxies for long-term success (DeAngelis, 2019b; Hitt, McShane, & Wolf, 2018).

The models indicate positive relationships between per pupil spending and test-based outcomes for public charter schools and null to negative relationships for district-run public schools. One takeaway could be that money matters more in public charter schools than district-run public schools, perhaps because they have stronger financial incentives to spend wisely. However, there are other possible explanations for the results. For example, although each model controls for the percent of students identified as having learning disabilities, data on specific learning disabilities are not available. It is possible that district-run public schools serve more students with severe learning disabilities than public charter schools. District-run public schools that have students with the most severe disabilities could be receiving the most dollars while achieving the worst test-based outcomes, which could explain the null to negative relationships. It is also possible that higher levels of per pupil spending are positively associated with outcomes that are not specifically examined in this study for district-run public schools.

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Appendix

Table A1: Per Pupil Expenditures by Sector (Non-Linear)

	Per Pupil Expend	**Per Pupil Expend**	**Per Pupil Expend**	**Per Pupil Expend**	**Per Pupil Expend**	**Per Pupil Expend**
Charter	-0.322***	-0.320***	-0.323***	-0.323***	-0.323***	-0.318***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Enrollment (100s)	-0.001*	-0.001+	-0.001*	-0.001+	-0.001+	-0.001+
	(0.022)	(0.054)	(0.040)	(0.061)	(0.059)	(0.094)
Black (%)		0.002***	0.002***	0.001**	0.001**	0.001**
		(0.000)	(0.000)	(0.003)	(0.006)	(0.002)
Hispanic (%)		0.002***	0.002***	0.001**	0.001**	0.001**
		(0.000)	(0.000)	(0.002)	(0.003)	(0.002)
White (%)		0.002***	0.002***	0.002***	0.002***	0.002***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female (%)		0.000	-0.000	-0.000	-0.000	-0.000
		(0.836)	(0.724)	(0.868)	(0.858)	(0.787)
SPED (%)			-0.001**	-0.001**	-0.001**	-0.001*
			(0.009)	(0.003)	(0.003)	(0.033)
Econ (%)				0.001***	0.001***	0.001***
				(0.001)	(0.001)	(0.000)
Title 1 (%)				0.000	0.000	0.000
				(0.662)	(0.676)	(0.813)
ESL (%)					-0.000	0.000
					(0.930)	(0.901)
LEP (%)					-0.000	0.000
					(0.864)	(0.915)
GT (%)						0.001**
						(0.002)
CTE (%)						-0.000
						(0.865)
R-Squared	0.8108	0.8136	0.8139	0.8147	0.8147	0.8153
N	5420	5420	5420	5420	5420	5420

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Each Model controls for city, school level, and campus type. The dependent variable is the natural log of district-level expenditures per pupil.

Table A2: Per Pupil Expenditures by Sector (School-Level)

	Per Pupil Expend	**Per Pupil Expend**	**Per Pupil Expend**	**Per Pupil Expend**	**Per Pupil Expend**	**Per Pupil Expend**
Charter	-0.729***	-0.711***	-0.303*	-0.292*	-0.308*	-0.143
	(0.000)	(0.000)	(0.039)	(0.047)	(0.038)	(0.351)
Enrollment (100s)	-0.098***	-0.089***	-0.080***	-0.079***	-0.079***	-0.075***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Black (%)		0.029***	0.017***	0.010*	0.014**	0.015***
		(0.000)	(0.000)	(0.021)	(0.001)	(0.000)
Hispanic (%)		0.025***	0.016***	0.008*	0.009*	0.009*
		(0.000)	(0.000)	(0.024)	(0.020)	(0.021)
White (%)		0.011**	0.002	0.003	0.007+	0.008*
		(0.003)	(0.540)	(0.422)	(0.076)	(0.024)
Female (%)		-0.020+	0.012	0.013	0.014	0.014
		(0.081)	(0.168)	(0.132)	(0.101)	(0.129)
SPED (%)			0.152***	0.150***	0.151***	0.156***
			(0.000)	(0.000)	(0.000)	(0.000)
Econ (%)				0.008*	0.006+	0.008*
				(0.011)	(0.068)	(0.019)
Title 1 (%)				-0.000	-0.000	-0.000
				(0.505)	(0.665)	(0.610)
ESL (%)					0.003	0.002
					(0.304)	(0.426)
LEP (%)					0.007**	0.008**
					(0.009)	(0.001)
GT (%)						0.016***
						(0.000)
CTE (%)						0.008***
						(0.000)
R-Squared	0.3861	0.4227	0.4950	0.4969	0.4987	0.5044
N	5472	5472	5472	5472	5472	5472

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Each Model controls for city, school level, and campus type. Expenditure data are reported at the school-level.

Table A3: Per Pupil Revenue by Sector (Non-Linear)

	Per Pupil Revenue ($1,000s)	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**	**Per Pupil Revenue ($1,000s)**
Charter	-0.166***	-0.165***	-0.164***	-0.163***	-0.165***	-0.160***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Enrollment (100s)	-0.001***	-0.001**	-0.001**	-0.001**	-0.001**	-0.001*
	(0.000)	(0.002)	(0.004)	(0.006)	(0.006)	(0.015)
Black (%)		0.000+	0.000+	0.000	0.000	0.000
		(0.052)	(0.084)	(0.647)	(0.435)	(0.158)
Hispanic (%)		0.001**	0.000**	0.000	0.000	0.000+
		(0.003)	(0.006)	(0.301)	(0.163)	(0.088)
White (%)		0.000	0.000	0.000	0.000	0.000
		(0.378)	(0.457)	(0.388)	(0.240)	(0.119)
Female (%)		-0.001+	-0.001	-0.000	-0.000	-0.001
		(0.086)	(0.157)	(0.187)	(0.203)	(0.162)
SPED (%)			0.001+	0.000	0.000	0.001*
			(0.068)	(0.122)	(0.241)	(0.021)
Econ (%)				0.000*	0.000+	0.000*
				(0.041)	(0.053)	(0.016)
Title 1 (%)				0.000	0.000	0.000
				(0.456)	(0.562)	(0.851)
ESL (%)					0.000*	0.000**
					(0.016)	(0.006)
LEP (%)					-0.000	-0.000
					(0.454)	(0.838)
GT (%)						0.001***
						(0.000)
CTE (%)						-0.000
						(0.717)
R-Squared	0.8105	0.8138	0.8140	0.8146	0.8149	0.8167
N	5420	5420	5420	5420	5420	5420

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Student demographics are proportions. Each model controls for city, school level, and campus type. The dependent variable is the natural log of district-level revenues per pupil.

Table A4: Cost-Effectiveness by Sector (Non-Linear)

	Meets per $1,000	**Masters per $1,000**	**Meets per $1,000**	**Masters per $1,000**
Charter	0.337***	0.361***	0.178***	0.202***
	(0.000)	(0.000)	(0.000)	(0.000)
Enrollment (100s)	0.001	0.004*	0.001	0.004*
	(0.450)	(0.019)	(0.490)	(0.018)
Black (%)	-0.011***	-0.017***	-0.010***	-0.016***
	(0.000)	(0.000)	(0.000)	(0.000)
Hispanic (%)	-0.006***	-0.012***	-0.005***	-0.011***
	(0.000)	(0.000)	(0.000)	(0.000)
White (%)	-0.006***	-0.009***	-0.004***	-0.007***
	(0.000)	(0.000)	(0.000)	(0.000)
Female (%)	0.006***	0.007**	0.006***	0.007**
	(0.000)	(0.003)	(0.000)	(0.001)
SPED (%)	-0.004**	-0.011***	-0.007***	-0.014***
	(0.004)	(0.000)	(0.000)	(0.000)
Econ (%)	-0.007***	-0.010***	-0.007***	-0.010***
	(0.000)	(0.000)	(0.000)	(0.000)
Title 1 (%)	-0.000	-0.000	-0.000+	-0.000
	(0.100)	(0.246)	(0.060)	(0.227)
ESL (%)	-0.004***	-0.006***	-0.004***	-0.006***
	(0.000)	(0.000)	(0.000)	(0.000)
LEP (%)	-0.000	0.001	-0.000	0.001
	(0.448)	(0.281)	(0.339)	(0.293)
GT (%)	0.006***	0.011***	0.006***	0.011***
	(0.000)	(0.000)	(0.000)	(0.000)
CTE (%)	-0.001+	-0.002***	-0.001*	-0.002***
	(0.065)	(0.001)	(0.042)	(0.000)
R-Squared	0.7703	0.7842	0.7882	0.7983
N	5167	5167	5167	5167

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Student demographics are proportions. Each model controls for city, school level, and campus type. Columns 1 and 2 are based on total per pupil expenditures. Columns 3 and 4 are based on total per pupil revenues. The dependent variable is the natural log of cost-effectiveness.

Table A5: Cost-Effectiveness by Sector (School-Level)

	Meets per $1,000	**Meets per $1,000**
Charter	-0.244	-0.104
	(0.251)	(0.407)
Enrollment (100s)	0.049***	0.019***
	(0.000)	(0.000)
Black (%)	-0.076***	-0.068***
	(0.000)	(0.000)
Hispanic (%)	-0.051***	-0.053***
	(0.000)	(0.000)
White (%)	-0.043***	-0.048***
	(0.000)	(0.000)
Female (%)	0.028*	0.008
	(0.015)	(0.221)
SPED (%)	-0.178***	-0.101***
	(0.000)	(0.000)
Econ (%)	-0.049***	-0.031***
	(0.000)	(0.000)
Title 1 (%)	-0.002*	-0.002***
	(0.038)	(0.000)
ESL (%)	-0.019***	-0.009***
	(0.000)	(0.000)
LEP (%)	-0.006*	-0.003
	(0.037)	(0.150)
GT (%)	0.047***	0.048***
	(0.000)	(0.000)
CTE (%)	-0.014***	-0.005***
	(0.000)	(0.000)
R-Squared	0.7245	0.7820
N	5217	5217

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. "SPED" is "Special Education." "Econ" is "Economically Disadvantaged." "ESL" is "English as a Second Language." "LEP" is "Limited English Proficiency." "GT" is "Gifted and Talented." "CTE" is "Career and Technical Education." Coefficients are average marginal effects. Student demographics are proportions. Each model controls for city, school level, and campus type.

Table A6: School Performance and Expenditures by Sector (School-Level)

	Meets (%)	**Masters (%)**
Per Pupil Expenditures (Charter)	1.984***	0.968**
	(0.000)	(0.004)
Per Pupil Expenditures (District)	-0.117	-0.144+
	(0.374)	(0.093)
Difference	2.101***	1.112**
	(0.000)	(0.001)
All Controls	Yes	Yes
R-Squared	0.8278	0.8392
N	5217	5217

Notes: P-values in parentheses. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. All observations are weighted by total enrollment. All models include all controls. Coefficients are average marginal effects. The difference is calculated by subtracting the coefficient for district-run public schools from the coefficient for public charter schools.

Table A7: School Performance and Expenditures by Sector (Non-Linear)

	Meets (%)	**Masters (%)**
Per Pupil Expenditures (Charter)	0.058***	0.080***
	(0.000)	(0.000)
Per Pupil Expenditures (District)	-0.009***	-0.015***
	(0.001)	(0.001)
Difference	0.067***	0.094***
	(0.000)	(0.000)
All Controls	Yes	Yes
R-Squared	0.7832	0.7970
N	5167	5167

Notes: P-values in parentheses. + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001. All observations are weighted by total enrollment. All models include all controls. Coefficients are average marginal effects. The difference is calculated by subtracting the coefficient for district-run public schools from the coefficient for public charter schools. The dependent variable is the natural log of the performance metric.

Table A8: School Performance and Revenues by Sector (Non-Linear)

	Meets (%)	**Masters (%)**
Per Pupil Revenues (Charter)	0.076***	0.107***
	(0.000)	(0.000)
Per Pupil Revenues (District)	-0.013+	-0.022*
	(0.067)	(0.039)
Difference	0.089***	0.129***
	(0.000)	(0.000)
All Controls	Yes	Yes
R-Squared	0.7843	0.7977
N	5167	5167

Notes: P-values in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All observations are weighted by total enrollment. All models include all controls. Coefficients are average marginal effects. The difference is calculated by subtracting the coefficient for district-run public schools from the coefficient for public charter schools. The dependent variable is the natural log of the performance metric.