

Education Expenditures and Student Achievement in Chicago Public Schools

A Senior Thesis
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by
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Abstract

Students in Chicago Public Schools (CPS), a large and diverse school district, are struggling to meet academic performance standards. A history of soft segregation practices in Chicago has left the district disproportionately minority and low-income, contributing to their lack of educational funding. This thesis utilizes data from the Illinois Report Card and the Civil Rights Data Collection to construct a sample of CPS schools spanning from 2009-2017. I employ a school and year fixed effects approach to estimate the impact of school expenditures on student achievement. I find a small positive effect of per-pupil school expenditures on school proficiency levels and student attendance. I then conduct a split sample regression analysis to compare my results across demographics. I find that these effects are more than twice as large for schools with a high enrollment percentage of Black students. My results have implications for federal education policy and provide support for the efficacy of targeted funding increases.

Acknowledgements

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Thanks for making senior year a memorable one, I look forward to seeing where life takes us.

Here's to good times, good laughs, and great friends.

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1. Introduction

[Chicago Public Schools \(CPS\)](#), the third largest school district in the United States, is chronically underperforming in educational achievement by its students. Although the district has led the nation in test score growth in recent years,¹ student proficiency levels in Math and English Language Arts (ELA) are still drastically lower than both Illinois and national averages. CPS schools also struggle with school attendance and chronic absenteeism. The district has a history of extreme inequality in school funding, stemming from racial segregation policies that have left the district disproportionately minority and low-income. Previous studies on educational inputs take a more aggregate approach towards explaining differences in student achievement across school districts. This does not account for the historical context and district-specific factors that impact achievement by CPS students. My thesis research attempts to understand the impact of school funding on student achievement by examining the individual characteristics of schools in the district. I also explore the economic mechanisms that are responsible for the disparity in overall educational achievement by CPS students.

Assessing educational achievement in the United States public school system has been the goal of numerous studies. Many of these studies focus on the effect of educational inputs on student achievement, and much of the research effort has gone into understanding the relationship between school expenditures and student achievement ([Ram, 2004](#)). According to the National Center for Education Statistics, school expenditures in the United States totaled over \$800 billion during the 2018-2019 academic year alone.² Despite significant allocation of financial resources towards education, evidence of a positive relationship between expenditures and student achievement is inconclusive. [Hanushek \(1986\)](#), through a survey of the existing literature at the time, established a consensus that there is no strong relationship between school expenditures and student achievement. More recent literature has gone against this consensus and strengthened the case for a positive relationship between expenditure and achievement. Studying the effect of school finance reforms, [Lafortune et al. \(2018\)](#) finds a significantly large effect of increased school resources on student achievement. In a study focused on elementary students in Michigan, [Chaudhary \(2009\)](#) finds a direct positive relationship between school expenditures and student test scores.

¹ Report by researchers at the [Center for Education Policy Analysis](#).

² Data from the [National Center for Education Statistics](#).

Differences in the allocation of expenditures may also help explain the relationship between school funding and student achievement. [Sander \(1999\)](#) finds that average teacher salaries have the largest effect on student tests scores when differentiating for expenditure type. Although recent literature suggests a new understanding of educational inputs, expanding research into this topic is crucial to understanding the true effect of expenditures on student achievement.

My research contributes to the academic literature on this subject in two distinct ways. The first distinction comes from the scope of my research question. Most previous studies estimate the average effect of school expenditures on student achievement across districts. This approach treats school districts as individual observations and neglects the extreme discrepancies in funding and achievement that may exist among schools within a highly diverse district such as CPS. My research focuses on characteristics of individual schools within a single school district, allowing me to analyze the economic mechanisms that impact student achievement at a local level. The second distinction comes from my measure of student achievement. Following the classification strategy in [Chaudhary \(2009\)](#), I use assessment proficiency levels rather than test scores as a measurement of student achievement. However, this previously mentioned study and others related focus on proficiency levels for a single assessment for a single grade level. My research uses composite proficiency levels across multiple assessments and grade levels to analyze student achievement more generally. I also introduce a new measure of student achievement by using student absences. [Lamdin \(1996\)](#) finds that school attendance rates are a significant predictor of student achievement. Because attending school is shown to be important to academic success, absences from school will have a negative impact on student achievement. My research leverages these findings by estimating the effect of school expenditures on student absences.

To explain the overall effect of school expenditures on student achievement, I use financial records and state assessment data for a sample of CPS schools from 2009-2017. [Ram \(2004\)](#) notes that fixed effects (FE) are a necessary specification for limiting unobservable bias when estimating expenditure effects on student achievement. Following the literature, I employ a school and year FE model to test the effect of total per-pupil expenditures on state assessment proficiency and student absences. I then differentiate between educational inputs by testing the FE model on personnel, non-personnel, and teacher salary expenditures independently. I also implement an interaction term between expenditures and school type to analyze the difference in effect of expenditures between public schools and charter schools. Finally, I compare the effects of

expenditures on achievement among key demographic percentiles using a split sample regression analysis.

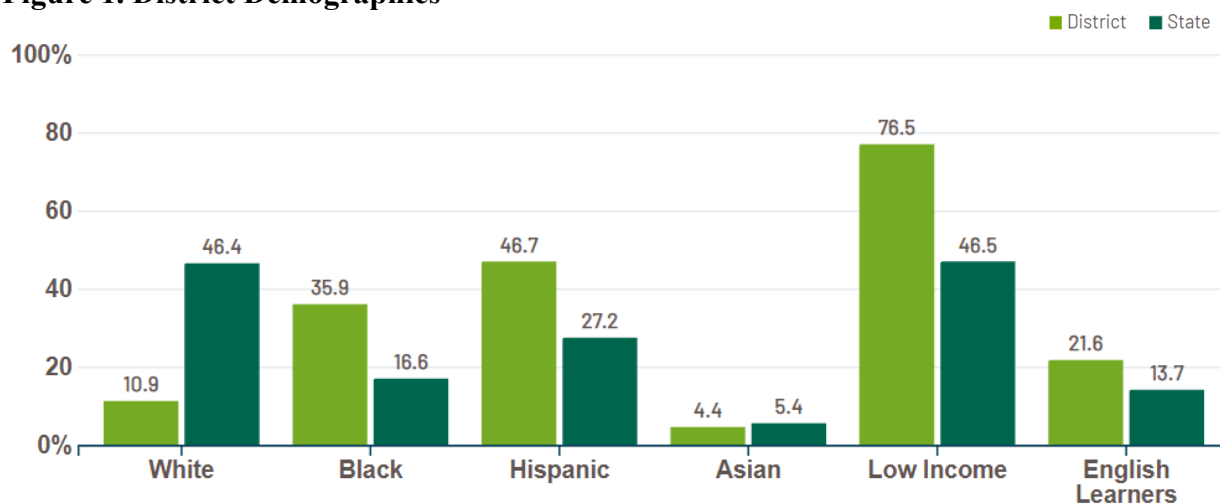
I find a small positive relationship between total per-pupil school expenditures and student achievement. Interpretation of my preferred specifications suggest that, on average, a \$1,000 increase in expenditures will improve school proficiency levels by 0.326 percentage points and decrease average student absences by 0.151 days. I also find that these effects are twice as large for CPS schools with a highly segregated school enrollment. While these estimates seem quantitatively modest, I provide an in-depth analysis of their relative effect for students in the district. This thesis also discusses the economic mechanisms behind my findings and their implications for federal funding programs.

The remainder of my thesis is organized by the following sections. Section 2 provides an overview of CPS and gives historical background to the funding and student achievement issues that exist within the school district. Section 3 introduces the data used for my research and discusses the notable discrepancies in expenditures and proficiency levels among schools in the district. Section 4 outlines my methodological approach and FE model specification to produce causal estimates of student achievement. Section 5 presents my headline results as well as secondary findings that differentiate between expenditure components and demographic groups. Section 6 concludes with a discussion of my findings, policy implications, and notes for future research.

2. Background

The Chicago Public Schools district is an important subject for research on education inputs due to its unique demographics and history. CPS is the largest school district in Illinois, and the third largest school district in the country. CPS operates 635 schools with total enrollment over 322,000 for the 2022-2023 academic year. CPS also recognizes 115 charter schools which have selective enrollment based on academic achievement. Although these charter schools adhere to performance standards set by the state, they have more autonomy regarding curriculum and expenditure allocation. The district is extremely diverse in its racial and socioeconomic composition. Black and Hispanic students make up over 82% of enrollment and only 11% of CPS students are White. Nearly 77% of CPS students are low-income and 22% have limited English proficiency (L.E.P).

Figure 1. District Demographics



Note: Figure 1 comes from the [Illinois State Board of Education](#).

Academic performance at CPS schools has been a major concern for families, educators, and policymakers. Roughly 20% of CPS students are proficient in ELA and only 16% are proficient in Math. These percentages are extremely low when compared to state and national averages. Data from the Illinois State Board of Education show that for 55 CPS schools in 2022, there was not a single student that met state standards in ELA or math. Notably, all these schools are located on the Southside of Chicago which has a high concentration of minority and low-

Figure 2. District Proficiency

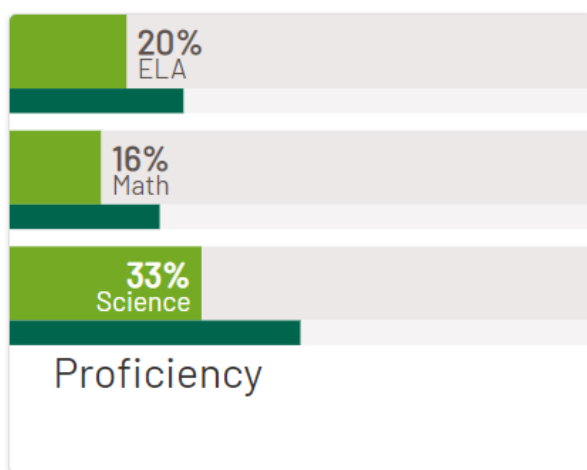
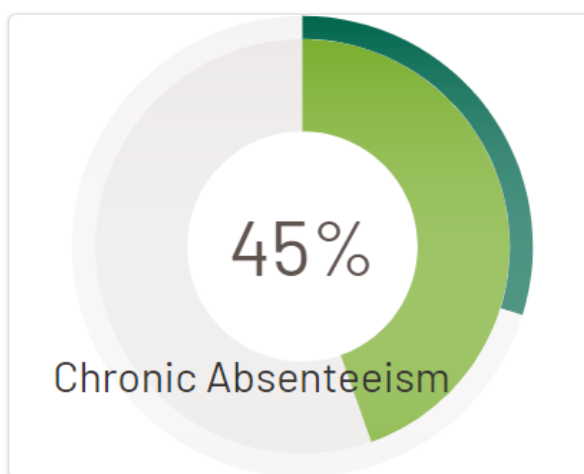


Figure 3. District Absenteeism



Note: Figures 2 and 3 come from the [Illinois State Board of Education](#).

income families.³ Another report from 2018 revealed that over half of CPS schools received a low performance rating by the state’s accountability system. More startling, the report highlighted the achievement discrepancies that exist for Black, Hispanic, low-income, and L.E.P students. The report also discussed achievement issues related to chronic absenteeism⁴ in the district, which reached as high as 45% in 2022. A head administrator for the district argued that more state and federal funding needs to be made available for the lowest performing schools to close these achievement gaps.

Education funding has historically been an issue for the school district. Financing for CPS comes from local tax appropriations as well as state and federal education funding programs. Because most of the district revenue comes from the local tax base, school funding is determined by family incomes within the district boundaries. Soft segregation policies in the early 20th century such as ‘red lining’⁵ and ‘white flight’⁶ left the district overwhelmingly minority and low-income,

Figure 4. Redlining Map

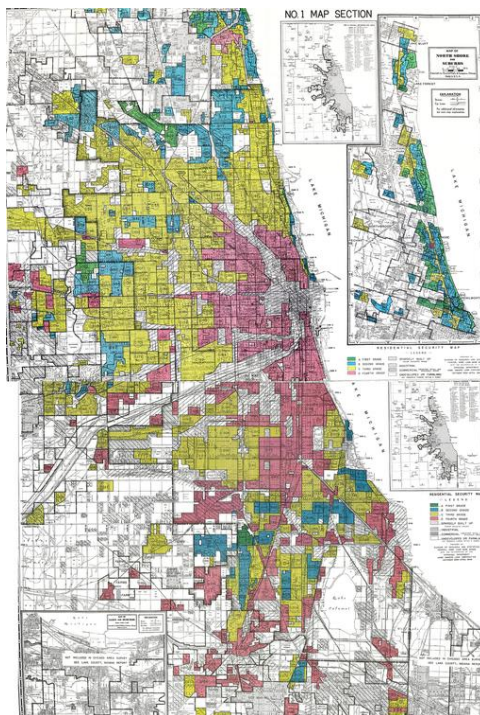
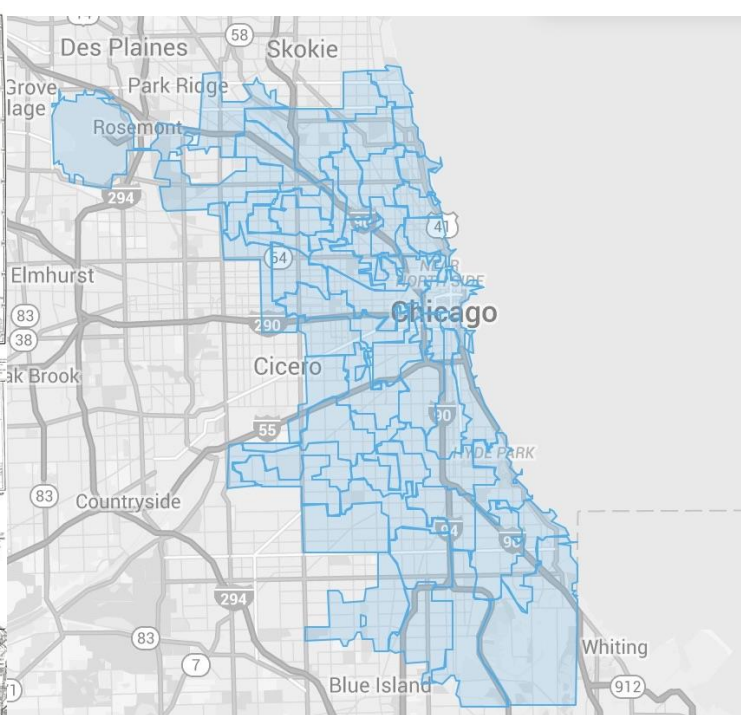


Figure 5. CPS District Map



Note: Figure 4 comes from the [Elmhurst Art Museum](#). Figure 5 comes from [Chicago Councilmatic](#).

³ Article from [Chalkbeat Chicago](#).

⁴ Definition and overview by the [Department of Education](#).

⁵ Article from [History.com](#).

⁶ Article from the [Brookings Institute](#).

effectively wiping out the tax base and crippling school funding. During the late 1960's, CPS schools were struggling to support their operations, and many closed. In 1973, the state established the Illinois Resource Equalizer Formula⁷ which restructured school financing by shifting the cost of education away from local tax and towards state sources. This new structure was particularly beneficial for low-income districts like CPS. This policy was protested by wealthy White communities around Chicago, and was ultimately abolished in the late 1980's.

Since this policy reversal, CPS has continued to experience acute funding problems. Currently, CPS spends on average approximately \$17,000 per student, which is lower than the Illinois state average. Between 2001-2009, nearly 100 CPS schools closed due to funding issues. Almost 90% of the students that were affected by these closings were Black and low-income. Because school funding has played such a large role in the history of CPS, it is vital to assess the true impact that educational expenditures have on student achievement. Determining this relationship will allow policymakers to better understand what needs to be done to fix the chronic academic performance issues that exist within the district.

3. Data

For my empirical analysis, I constructed a panel dataset of expenditure, assessment, attendance, and demographic data for Chicago Public Schools. The expenditure data come from the [Civil Rights Data Collection](#) and include observations for total expenditures, personnel versus non-personnel related expenditures, and teacher salary expenditures for every school in the district. These observations were reported every other academic year from 2008-2009 to 2016-2017. The data on student assessments, attendance rates, and school demographics come from the [Illinois Report Card](#) data library and include observations for assessment proficiency, school enrollment and school type, as well as racial and socioeconomic characteristics for every school in the district. These observations were reported annually from academic year 2001-2002 to 2021-2022. To reconcile these datasets and account for school openings and closures, I restricted my observations to CPS schools that were reported across each of the 5 academic years ending in 2009, 2011, 2013, 2015, and 2017. After limiting my data, I arrive at a sample of 483 schools (11 charter) observed over 5 years, or 2,415 total observations. This sample size represents roughly 77% of the total

⁷ Study by a researcher at the [Department of Education](#).

number of CPS schools that were operational in 2022. It is important to note that my sample does not discriminate by school type and includes schools serving various grade levels from PK-12.

My main outcome variables included in the dataset are school proficiency and school attendance. School attendance is observed as the average attendance rate for a given school each year. For the scope of my research, I would like to understand what factors impact student absences rather than school attendance. To do this, I rescaled my outcome variable to represent how many days on average students are absent from a given school each year. I computed these values using the annual number of instructional days (176) at CPS schools.

Within this dataset, I generated per-pupil variables for each expenditure account to accurately compare expenditure levels across schools in the district. Preliminary analysis of my main independent variable, total per-pupil expenditures, revealed a highly positive skew with large outliers which can be seen in Figure 6. Given the scope of my research, these outliers may not

Figure 6. Dist. of Expenditures

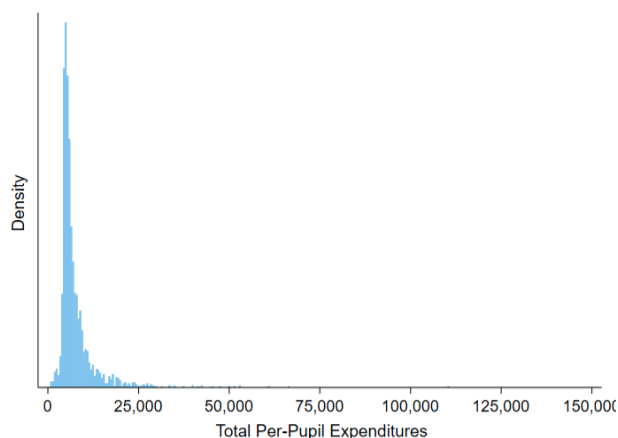
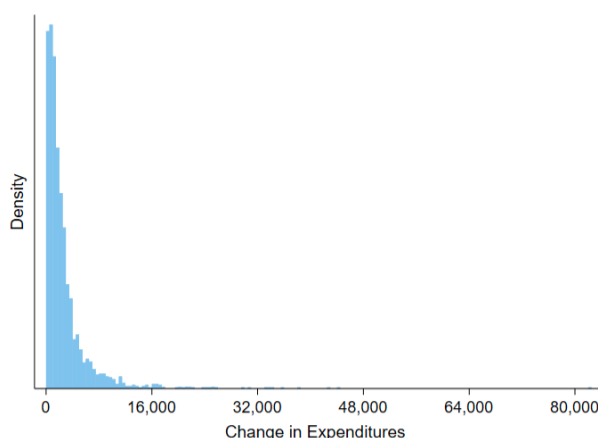


Figure 7. Dist. of Expenditure Change



harm the analysis as long as the variation in expenditures across the years for a given school falls within a more normal distribution. To determine if this assumption holds within my dataset, I generated a variable to analyze the absolute change in expenditures between the given year and the annual average. Displayed by Figure 7, this new distribution also exhibited a highly positive skew, confirming the existence of outliers in the variation of expenditures. To account for these outliers, I dropped any observation that exceeded a change in expenditures greater than 3 standard deviations from the mean. 46 total observations were removed from the dataset, representing

roughly 2% of the original sample. Both the change in expenditures as well as total per-pupil expenditures now fit a more normal distribution shown by Figures 8 and 9.

Figure 8. Restricted Expenditures

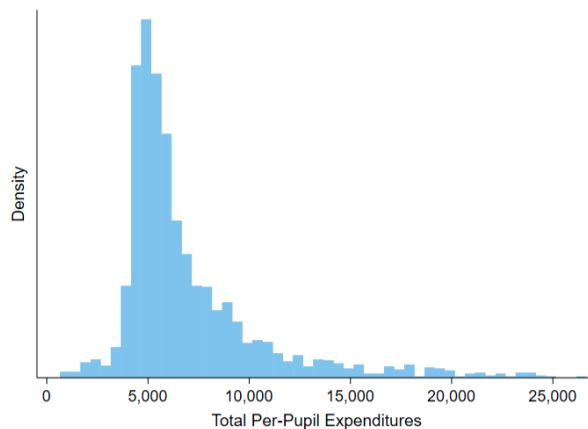


Figure 9. Restricted Change in Exp.

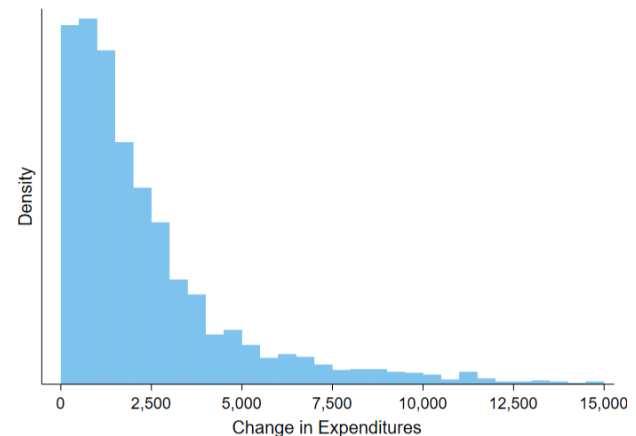


Table 1 displays summary statistics for my outcome variables and school expenditures. All statistics are given by annual averages for each variable. My main measurement of student achievement, composite proficiency percentage, highlights the discrepancy in educational outcomes within the district. On average, only 43.8% of students in CPS schools meet or exceed state standards. With a standard deviation of 18.8%, we can see that the difference in student achievement varies significantly across schools in the district. Analyzing the other outcome

Table 1: Outcomes and Expenditures

	Mean	SD	25 th	50 th	75 th
<u>Outcomes</u>					
Proficiency	43.8%	18.8%	32.0%	42.8%	55.2%
Days Absent	12.6	7.9	8.4	9.9	13.0
<u>PP Expenditures</u>					
Total	\$7344.09	\$2548.28	\$5452.97	\$6909.15	\$8639.79
Personnel	\$5746.42	\$1093.32	\$5029.09	\$5568.51	\$6205.98
Non-Personnel	\$1044.99	\$555.77	\$723.06	\$949.57	\$1190.93
Teachers	\$3816.25	\$590.30	\$3449.71	\$3717.84	\$4078.99

Note: Observations were the same across all variables (N: 2,368).

variable for my research, we can see that on average students at CPS schools are absent for 12.6 days every year. This figure may seem small, but it accounts for students being absent approximately 7% of the school year. Looking at the school expenditures, we see extreme discrepancy in per-pupil spending across schools in the district as well. On average, CPS schools spend roughly \$7,344 per pupil but with a standard deviation of around \$2,548. The different expenditure components follow similar trends as total per-pupil expenditures, save for teacher salary expenditures which have the smallest variation across schools.

Table 2 displays summary statistics for school demographics. All statistics are given by annual averages for each demographic. These selected characteristics demonstrate the extreme racial and socioeconomic diversity within CPS compared to national school district averages. On average, the student body at CPS schools is 48.7% Black, 37.4% Hispanic, and only 9.4% White. More importantly, percentiles for these demographics show the concentration of race across schools in the district. One quarter of all CPS schools are at least 97.5% Black, and another quarter are at least 76.9% Hispanic. The unique socioeconomic characteristics of this district are also crucial to my analysis. On average for schools in the district, 84.6% of enrollment is composed of

Table 2: School Demographics

	Mean	SD	25 th	50 th	75 th
<u>Enrollment</u>					
Total	675	442	381	551	824
Public	680	446	379	555	827
Charter	458	89	410	451	556
<u>Racial Composition</u>					
White	9.4%	16.6%	0.2%	1.1%	9.0%
Black	48.7%	42.4%	5.6%	36.0%	97.5%
Hispanic	37.4%	36.8%	1.7%	24.6%	76.9%
Asian	3.2%	8.0%	0.0%	0.2%	2.5%
<u>Socioeconomics</u>					
Low Income	84.6%	20.5%	84.3%	93.6%	96.6%
L.E.P.	15.1%	17.2%	0.5%	7.0%	28.5%

Note: Observations were the same across all variables (N: 2,368) except for Public (N: 2,316) and Charter (N: 57).

students that are considered low-income and half of the schools are at least 93.6% low-income. Another demographic of interest are students that are L.E.P., a significant indicator of student achievement. CPS schools are on average 15.1% L.E.P. These statistics greatly exceed national averages and give context to the racial and economic discrepancies that exist within CPS schools.

The final edit I make to my dataset is to scale all per-pupil expenditures to the thousands level. Because \$1,000 is roughly 40 percent of a standard deviation in total per-pupil expenditures, this adjustment will make it easier to interpret results across CPS schools. This unit transformation will allow also me to interpret my results in a more policy-oriented method, focusing on changes in school funding on a larger scale.

4. Methodology

The primary empirical specification that I employ in this paper is a fixed effects model. I use school and year FE to estimate the impact of expenditures on student achievement.

Equation 1:

$$Outcome_{st} = \alpha + \beta Expenditures_{st} + X_{st}\phi + \gamma_s + \delta_t + \epsilon_{st} \quad (1)$$

In Equation 1, $Outcome_{st}$ represents my measurement of student achievement at school s during academic year t . This term will take on values for either student proficiency, the composite percentage of students who meet or exceed state standards, or days absent, the average number of days that students are absent from school. $Expenditures_{st}$ represents school expenditures per-pupil in thousands at school s during academic year t . This term will take on values for different components of school expenditures, including total expenditures, personnel and non-personnel related expenditures, and teacher salary expenditures. X_{st} represents a vector of demographic controls for school s during academic year t . I selected my preferred controls based on findings from [Neymotin \(2010\)](#) that describe the demographic characteristics most important to student achievement. The term γ_s represents a time-invariant school fixed effect that controls for persistent unobserved differences across schools within the district. The term δ_t represents a school-

invariant time fixed effect that controls for persistent unobserved differences across academic years. The last term, ϵ_{st} represents the residual error for school s during year t .

The secondary empirical strategy that I employ utilizes the FE specification from the baseline model, but I now include an interaction term for school expenditures and school type.

Equation 2:

$$\begin{aligned} Outcome_{st} = & \alpha + \beta_1 Expenditures_{st} + \beta_2 (Expenditures_{st} * Charter_s) \\ & + X_{st}\phi + \gamma_s + \delta_t + \epsilon_{st} \end{aligned} \quad (2)$$

For the sake of brevity, all the terms are the same as Equation 1 except for the interaction term. $Charter_s$ is a dummy variable representing school type where public schools are equal to 0 and charter schools are equal to 1. Using this interaction term will allow me to estimate the difference in effect of school expenditures on student achievement between public and charter schools in the district.

To estimate the true causal effect of expenditures on student achievement, the assumption must hold that there are no variations among schools in the district or across the academic years that are correlated with changes in student achievement. Current trends show that CPS enrollment has declined by nearly 20% over the past 11 academic years,⁸ which has a large impact on district funding decisions. Employing a FE model allows me to control for important heterogeneity implicit in my dataset. Including school-level and year-specific FE will control for persistent differences across schools and academic years that could impact my outcome variables, such as district revenue, teacher quality, and physical infrastructure. By controlling for these unobserved variations, I can estimate a causal relationship between expenditures and student achievement.

5. Results

Using Equation 1 and excluding demographic controls, I find that a \$1,000 increase in total per-pupil expenditures increases school proficiency by 0.232 percentage points. I also find that a \$1,000 expenditure increase leads to a decrease in average absences by 0.129 days. Table 3

⁸ Article from [Illinois Policy](#).

displays my primary results for both outcome variables. Including school demographics increases the magnitude of the expenditure coefficient and substantially increases the R-squared estimates for both models. My preferred model specifications, presented in columns (2) and (4), now show that a \$1,000 increase in expenditures leads to an increase in proficiency by 0.326 percentage points and a decrease in absences by 0.151 days. The key coefficients for total per-pupil expenditures are statistically significant across all 4 models.

Although my estimates for the proficiency models are significant, their relative effects appear quantitatively modest. Using the estimates from column (2), expenditure increases of greater than 1 standard deviation are required to improve school proficiency by 1 percentage point. These results are consistent with [Ram \(2004\)](#) and [Chaudhary \(2009\)](#) who also produce small positive coefficients. My estimates for the absence models show a similarly small relative effect.

Table 3: Fixed Effects Results - Total

<i>Dependent Variable:</i>	(1)	(2)	(3)	(4)
	Proficiency		Days Absent	
Expenditures	0.232** (0.111)	0.326*** (0.112)	-0.129*** (0.0451)	-0.151*** (0.0455)
White		-0.284 (0.208)		-0.143** (0.0719)
Black		-0.657*** (0.207)		0.0177 (0.0691)
Hispanic		-0.598*** (0.206)		-0.0379 (0.0667)
Asian		-0.147 (0.218)		-0.120* (0.0666)
Low-Income		-0.212*** (0.0594)		-0.0818*** (0.0309)
L.E.P.		0.0229 (0.0613)		0.0216 (0.0235)
Constant	59.07*** (1.561)	133.2*** (19.86)	15.08*** (0.84)	24.00*** (6.594)
Observations	2,363	2,363	2,368	2,368
R-squared	0.4386	0.6894	0.0215	0.0796

(Robust standard errors)

*** p < 0.01, ** p < 0.05, * p < 0.1

Using estimates from column (4), an expenditure increases of greater than 2.5 standard deviations is required to reduce absences by 1 day. All my primary results are consistent with the relevant literature, indicating a small positive effect of expenditures on student achievement.

Continuing my analysis, I estimate Equation 1 again and differentiate my key school expenditure variable by expenditure sub-components. These secondary results are displayed in Table 4. I find no significant effect of per-pupil personnel related expenditures on either school proficiency or student absences. Although the coefficient is the same as total per-pupil expenditures, the standard error is larger, rendering my estimates imprecise. I find similar results for the effect of per-pupil teacher salary expenditures as well. This finding differs from [Sander](#)

Table 4: Fixed Effects Results - Expenditure Components

<i>Dependent Variable:</i>	Personnel		Non-Personnel		Teachers	
	(1) Prof	(2) Abs	(3) Prof	(4) Abs	(5) Prof	(6) Abs
Expenditures	0.311 (0.253)	0.0515 (0.0854)	-0.871** (0.444)	0.345** (0.147)	0.506 (0.328)	-0.0601 (0.125)
White	-0.293 (0.203)	-0.141** (0.0662)	-0.288 (0.192)	-0.140** (0.0662)	-0.291 (0.205)	-0.140** (0.0673)
Black	-0.659*** (0.203)	0.0108 (0.0643)	-0.641*** (0.191)	0.00820 (0.0642)	-0.656*** (0.204)	0.0133 (0.0650)
Hispanic	-0.602*** (0.202)	-0.0427 (0.0618)	-0.587*** (0.191)	-0.0454 (0.0616)	-0.601*** (0.203)	-0.0407 (0.0626)
Asian	-0.154 (0.213)	-0.124** (0.0609)	-0.138 (0.203)	-0.126** (0.0606)	-0.155 (0.215)	-0.121* (0.0619)
Low-Income	-0.215*** (0.0596)	-0.0769** (0.0309)	-0.219*** (0.0593)	-0.0768** (0.0308)	-0.213*** (0.0597)	-0.0784** (0.0312)
L.E.P.	0.0237 (0.0617)	0.0212 (0.0238)	0.0165 (0.0618)	0.0232 (0.0238)	0.0245 (0.0616)	0.0213 (0.0236)
Constant	134.7*** (19.38)	22.26*** (5.825)	137.4*** (18.38)	22.25*** (5.939)	134.5*** (19.46)	22.81*** (6.062)
Observations	2,363	2,368	2,363	2,368	2,363	2,368
R-squared	0.6864	0.0752	0.6877	0.0758	0.6869	0.0737

(Robust standard errors)

*** p < 0.01, ** p < 0.05, * p < 0.1

(1999) and Chaudhary (2009), who find that increases in teacher salary expenditures have the greatest effect on student achievement. Interestingly, my estimates for non-personnel related expenditures produce statistically significant coefficients but show an opposite effect than my primary results. Looking in column (3), we see that a \$1,000 increase in non-personnel expenditures decreases school proficiency by 0.871 percentage points. The same expenditure increases lead to an increase in student absences by 0.345 days. The relative effects are still low, but the coefficient magnitudes are much larger than those estimated in my preferred model specifications. These results indicate that school expenditures on non-personnel related educational inputs have a negative impact on student achievement.

Analysis of my primary results show relatively small positive effects of school expenditures on student achievement for my sample of CPS schools. Consistent across all my estimations are statistically significant, and relatively large, coefficients for specific demographic controls. Comparable to the findings by Neymotin (2010), demographics seem to be a significant predictor of student achievement at CPS schools. As discussed before, the racial and socioeconomic composition of this district is particularly unique. Notably, schools in the district have an extremely high concentration of both Black and low-income students. It may be possible that per-pupil expenditures have a different effect on student achievement depending on the school enrollment percentages of both Black and low-income students.

Figure 10 displays the distribution of school enrollment percentage of Black students. We can clearly see that there are large concentrations of schools that either have very low or very high Black enrollment percentages. The vertical navy line on the left represents the 25th percentile

Figure 10. Dist. of Black Students

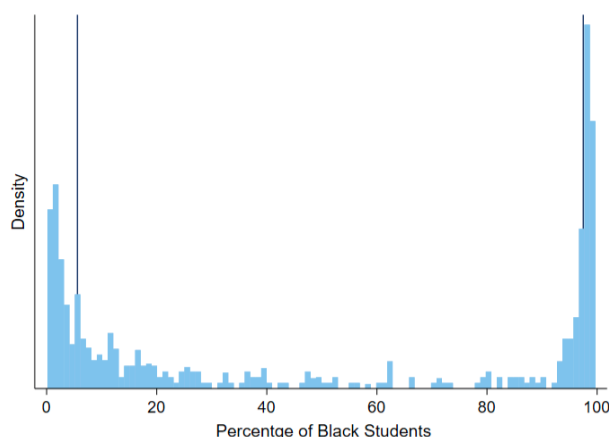
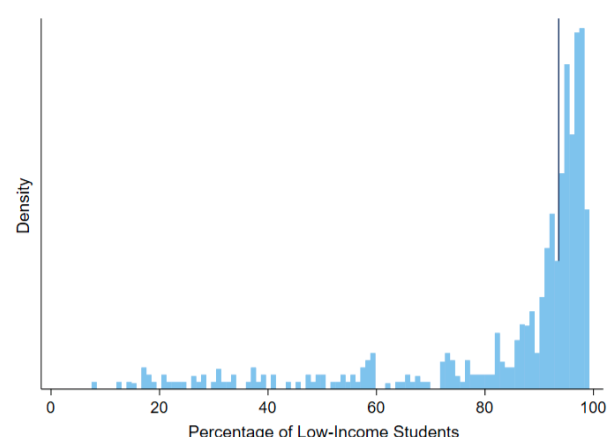


Figure 11. Dist. of Low-Income Students



while the vertical navy line on the right represents the 75th percentile. To isolate the expenditure effect within these highly concentrated schools, I perform a split sample regression analysis on schools within the 1st quartile, interquartile range (2nd and 3rd quartiles), and 4th quartile. Figure 11 displays the distribution of school enrollment percentage of low-income students. We observe a highly negative skew in the distribution, revealing a large concentration of schools with enrollments that are largely low-income students. The vertical navy line represents the median value. To isolate the expenditure effect, I again perform a split sample regression analysis on schools below (1st and 2nd quartiles) and above (3rd and 4th quartiles) the median.

Using Equation 1, I estimate the effect of total per-pupil expenditures on school proficiency and student absences for each of the three Black student enrollment samples. Table 5 displays

Table 5: Split Sample Results - Pct. Black

<i>Dependent Variable:</i>	Q1		Q2 & Q3		Q4	
	(1) Prof	(2) Abs	(3) Prof	(4) Abs	(5) Prof	(6) Abs
Expenditures	-0.468*** (0.155)	0.0608 (0.0529)	0.496*** (0.169)	-0.124* (0.0667)	0.707*** (0.208)	-0.428*** (0.105)
White	-0.0218 (0.397)	-0.0459 (0.139)	-0.270 (0.273)	-0.0969 (0.0858)	-1.603 (2.576)	0.992 (1.199)
Black	-0.232 (0.557)	0.0736 (0.163)	-0.404 (0.271)	-0.0701 (0.0820)	-0.414 (1.247)	0.215 (0.556)
Hispanic	-0.312 (0.347)	-0.0187 (0.111)	-0.406 (0.275)	-0.0880 (0.0795)	0.213 (1.364)	-0.526 (0.726)
Asian	0.0991 (0.361)	-0.0489 (0.116)	0.0814 (0.285)	-0.199** (0.0784)	-4.877 (4.910)	1.287 (2.433)
Low-Income	-0.109* (0.0630)	-0.0128 (0.0202)	-0.495*** (0.0714)	0.0331 (0.0319)	0.345* (0.193)	-0.278*** (0.0975)
L.E.P.	-0.0763 (0.0701)	-0.00508 (0.0266)	0.100 (0.0826)	-0.0217 (0.0357)	1.269 (0.846)	-0.796** (0.373)
Constant	109.0*** (37.88)	11.78 (12.81)	129.6*** (25.54)	21.51*** (7.700)	54.88 (126.8)	27.20 (59.25)
Observations	595	595	1,178	1,182	587	589
R-squared	0.8307	0.0503	0.7244	0.0976	0.605	0.0957

(Robust standard errors)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

estimates from each sample for both outcome variables. Within the 1st quartile, I find a statistically significant negative relationship between expenditures and school proficiency. This estimation is inconsistent with my primary results and with the relevant literature. I find no significant effect of expenditures on absences within the 1st quartile. I find that schools within the 2nd and 3rd quartiles experience a significant positive effect of expenditures on school proficiency. The relationship between expenditures and absences is also insignificant for this sample. Estimates for schools within the 4th quartile are most notable for my split sample regression analysis. I find that a \$1,000 increase in expenditures increases school proficiency by 0.707 percentage points. This coefficient, shown in column (5), is statistically significant and has a much larger magnitude than my preferred specification. I also find that the same increase in expenditures leads to a decrease in student

Table 6: Split Sample Results - Pct. Low-Income

<i>Dependent Variable:</i>	Q1 & Q2		Q3 & Q4	
	(1) Prof	(2) Abs	(3) Prof	(4) Abs
Expenditures	0.414*** (0.144)	-0.256*** (0.0708)	0.285* (0.167)	-0.0590 (0.0549)
White	-0.229 (0.264)	-0.248* (0.130)	0.206 (0.303)	-0.00960 (0.114)
Black	-0.564** (0.265)	-0.0915 (0.121)	-0.243 (0.264)	0.103 (0.0856)
Hispanic	-0.516* (0.266)	-0.141 (0.119)	-0.195 (0.263)	0.0527 (0.0849)
Asian	0.0302 (0.284)	-0.265** (0.125)	0.117 (0.267)	-0.0299 (0.0858)
Low-Income	-0.240*** (0.0641)	-0.0334 (0.0353)	0.403*** (0.125)	-0.270*** (0.0672)
L.E.P.	-0.0366 (0.0768)	0.0142 (0.0339)	0.100 (0.0974)	0.00918 (0.0301)
Constant	124.8*** (25.41)	34.33*** (12.23)	35.37 (26.95)	30.40*** (10.23)
Observations	1,183	1,186	1,180	1,182
R-squared	0.6274	0.1209	0.7539	0.1668

(Robust standard errors)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

absences by 0.428 days. Analogous to the proficiency model, this coefficient, shown in column (6), is statistically significant with a larger magnitude than my preferred specification. These results indicate that school expenditures have a larger impact on student achievement in schools that have a high enrollment percentage of Black students.

Using Equation 1, I estimate the effect of total per-pupil expenditures on school proficiency and student absences for both low-income student enrollment samples. Table 6 displays estimates from each sample for both outcome variables. I find statistically significant effects of total per-pupil expenditures on both school proficiency and student absences for the sample of schools below the median, shown in columns (1) and (2). These key coefficients are similar to my preferred

Table 7: Charter Interaction Results

<i>Dependent Variable:</i>	(1) Proficiency	(2) Proficiency	(3) Days Absent	(4) Days Absent
Expenditures	0.248** (0.115)	0.337*** (0.116)	-0.131*** (0.0464)	-0.151*** (0.0467)
Expenditures * Charter	-0.271 (0.280)	-0.179 (0.288)	0.0495 (0.0752)	0.0102 (0.0713)
White		-0.286 (0.208)		-0.143** (0.0720)
Black		-0.659*** (0.207)		0.0177 (0.0690)
Hispanic		-0.600*** (0.206)		-0.0379 (0.0667)
Asian		-0.150 (0.218)		-0.120* (0.0668)
Low-Income		-0.212*** (0.0594)		-0.0818*** (0.0309)
L.E.P.		0.0235 (0.0614)		0.0216 (0.0235)
Constant	59.00*** (1.575)	133.4*** (19.84)	15.09*** (0.843)	24.00*** (6.587)
Observations	2,363	2,363	2,368	2,368
R-squared	0.4391	0.6895	0.0212	0.0795

(Robust standard errors)

*** p < 0.01, ** p < 0.05, * p < 0.1

model specification and indicate that expenditures have a positive effect on student achievement for schools with a wide range of low-income student enrollment. Interestingly, I find no significant effect of expenditures on either outcome variable for the sample of schools above the median, shown by columns (3) and (4). This indicates that there is no effect of expenditures on student achievement for schools with a high concentration of low-income students. This result is inconsistent with findings in [Card \(2002\)](#) which estimate a greater effect of expenditures on student achievement for low-income students when compared to higher income students. The insignificant results for student absences can possibly be explained by findings in [Lamdin \(1996\)](#), which discuss how attendance rates are influenced by factors such as student motivation and family concern.

Using Equation 2, I estimate the difference in effect of total per-pupil expenditures between public and charter schools. Table 7 presents my results for both outcome variables. I find no significant difference in effect of expenditures on school proficiency or student absences across all the models. Expenditure coefficients, which estimate the effect on public schools when the Charter variable is equal to 0, are analogous to my primary estimates from Equation 1. These results indicate that expenditures have the same effect on school proficiency and student absences in both public and charter schools, however I suspect that the insignificant findings may come from the relatively small number of charter schools in the sample.

6. Conclusion

My key findings provide evidence of a positive relationship between per-pupil school expenditures and student achievement. Controlling for school demographics increased the strength of this relationship, which leads me to believe that there is a causal effect of expenditures on achievement. Although my analysis produced significant results, my findings need to be put into context given their relevant effect. The majority of CPS school expenditure increases year-to-year are between \$0 and \$2,500 per-pupil. On average, increasing expenditures by \$2,500 at every school would increase proficiency in the district by less than one percent. Using enrollment averages for my sample and expanding this to the 635 CPS schools, this expenditure increase would help roughly 3,490 nonproficient students become proficient on their standardized tests. While this number of students is incredibly small when compared to the total district enrollment, we must consider that these are people not data points. Data from the United States Bureau of

Labor Statistics show that median wages are higher and unemployment rates are lower for students with a high school diploma than those without one.⁹ Helping even a small number of students become proficient will have positive economic benefits. There is also research evidence to support the notion that higher achieving students have a positive effect on the academic achievement of their peers.¹⁰ Therefore, increased school funding will see direct, and indirect positive effects on student achievement.

My findings indicate similar relative effects on student absences as well. Using the \$2,500 per-pupil expenditure increase, average student absences would decrease by about one third of a day. This appears to be a small effect, but further analysis can tell a different story. Using enrollment averages for my sample, this corresponds to roughly 255 fewer annual absences per school. Most of these absences are from students classified as chronically absent, which is roughly 45 percent of CPS students. If we assume that school absences come only from these students, then a \$2,500 expenditure increase would reduce average absences by nearly an entire day. Given that average annual absences are 12.9, increased funding can improve the attendance of chronically absent students by 6.4 percent. Knowing that attendance is a significant predictor of student achievement, these findings have major educational implications.

My most important finding comes from the split sample regression analysis of CPS schools with highly segregated school enrollment. The observed effects of per-pupil expenditures on student achievement were twice as large for this sample as they were on average for my full sample of CPS schools. Many studies have shown that school demographics play a large role in predicting student achievement, but few have investigated the direct impact of expenditures on student achievement compared across schools with different levels of integration. Important findings by [Card \(2007\)](#) show that highly segregated schools experience persistently lower achievement levels than schools with higher racial integration. This leads me to believe that CPS schools with a large concentration of Black students realize a higher marginal return of student achievement when given the same increase in funding. This indicates that, because these schools have lower student achievement to begin with, increasing expenditures is more effective at helping these students ‘catch up’ to students at higher performing schools. It is likely that when achievement levels approach the average, this effect is diminished and more comparable to the average effect from

⁹ Data from the [Bureau of Labor Statistics](#).

¹⁰ Evidence from the [Federal Reserve Bank of Boston](#).

my primary findings. Data from the United States Department of Labor show that Black workers make on average 75 percent as much as White workers.¹¹ Given the effects of educational attainment on wages, it is crucial from an equity point of view to improve student achievement in these specific schools to help reduce this racial pay gap.

Further analysis of my results shed light on some unexpected findings and the limitations of my research. The first of these comes from my split sample regression analysis of CPS schools with high enrollment percentages of low-income students. I find no causal relationship between per-pupil expenditures and student achievement for this sample. This finding contrasts with the literature which agrees that increased funding should have a larger effect on proficiency for low-income students. Although my primary results showed a link between expenditures and absences, data on chronic absenteeism suggest that family and health factors may be influencing student attendance more than educational inputs.¹² However, I believe that my methodology in constructing this split sample regression analysis played a role in producing insignificant results. My findings concerning the relationship between expenditures and achievement in highly segregated schools were significant. Looking closer at the data, most Black students in the district are considered low-income. Because these two variables are highly correlated, it is possible that any significant effects of expenditures are being hidden by the large effects of the racial controls. Future research effort should be directed towards developing a consensus on how to accurately measure student achievement.

Another unexpected finding from my results is that there is no significant relationship between teacher salary expenditures and student achievement. This finding is contrary to the existing literature that finds teacher-related educational inputs to be a large predictor of student achievement. It is possible that using per-pupil teacher salary expenditures is not a good measurement of teacher quality, and that other popular educational inputs such as student-teacher ratio and class¹³ size may be better at understanding what educational inputs influence student achievement. This finding highlights a significant limitation of my research. My only variables of interest concern expenditure-related educational inputs. There are other non-financial inputs that

¹¹ Data from the [Department of Labor](#).

¹² Study by the [Economic Policy Institute](#).

¹³ Literature Review from the [Brookings Institute](#).

play a large role in student achievement and educational outcomes. Further research should explore other educational inputs that may have a more significant impact on student achievement.

The last unexpected finding that comes from my research concerns the difference in effect of expenditures between public schools and charter schools. Because charter schools are allowed more autonomy with their funding and curriculum, I expected to find a more efficient relationship between charter expenditures and student achievement than the average effect on public schools. I theorize that my results are insignificant because the number of charter school observations in my dataset was too small. Out of a sample of 483 CPS schools only 11 of them were labeled as charter schools. These unbalanced observations may have produced inaccurate or potentially biased estimations. It is also possible that there is no significant difference in effect and that this is the true relationship. Data on charter school performance suggest that, on average, these types of schools do not outperform traditionally funded public schools in student achievement.¹⁴ Whatever the case is, my lack of findings regarding the expenditure relationship for charter schools is a limitation on my analysis. Future research should consider using data with a sample of schools that is more balanced between public and charter.

My findings have important implications for developing effective and equitable education policy. Because most CPS revenue comes from its tax base, which consists of a highly impoverished population, there is little that state and local policymakers can do to support underperforming students in the district. However, allocating federal funds towards distressed districts may be an effective strategy to increase student achievement. This policy proposal is known as targeted funding increases and is already being discussed as a necessary step to overhaul education in the United States.

The Biden Administration has proposed increasing Title I funds which are aimed at increasing education spending primarily for low-income students. Recent studies provide evidence that increasing Title I allocations could be effective at narrowing the student achievement gap, particularly for minority students.¹⁵ However, the funds must be well targeted towards schools whose enrollments are the most in need. How to target these schools is also a topic of debate, as research shows most federal programs have been ineffective in getting the money to who is most

¹⁴ Report by the [Brookings Institute](#).

¹⁵ Report by the [Brookings Institute](#).

in need of it.¹⁶ Targeting criteria implemented by the federal government can have a large effect on whether educational funding is allocated equitably. My findings may provide important insights for policymakers working on developing and federal funding programs targeted towards districts like Chicago Public Schools.

In summary of my work, this thesis estimated the relationship between school funding and student achievement in the Chicago Public Schools district. I was able to determine that school expenditures have a small positive effect on school proficiency and student attendance, two persistent issues for the district. My findings contribute to a growing consensus in the economic literature that expenditure inputs do in fact have an impact on student achievement outcomes. These findings also have implications for education policy, specifically for federally targeted funding increases.

¹⁶ Policy Brief from the [Public Policy Institute of California](#).

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