“FAIR STUDENT FUNDING”: DID SCHOOL-LEVEL SPENDING BECOME MORE EQUITABLE IN NEW YORK CITY PUBLIC SCHOOLS AFTER 2007?

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All errors are entirely my own.

[1] Excerpted from , volume 8 (2010). Minneapolis: Fortress Press, page 154.
[2] …who fielded all the late-night phone calls (and always kept some vegan ice cream waiting for me!)
[3] …who is the Network Administrator, my Excel consultant, economics ’78, and P’12 (22)
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[5] …who inspires with her astonishing work ethic and never-quit attitude
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CHAPTER ONE: INTRODUCTION

In the United States, each state essentially runs a separate educational system, comprised of one or more local districts under its purview. Individual districts face unique circumstances, with each district drawing on a different tax base to serve a different combination of student needs. Outcomes vary widely. For example, almost half of fourth-graders in large cities are below proficient in reading skills, compared to about a third nationwide. Similar variation often exists within school districts as well. Thirteen percent of New York City students are considered advanced in science skills, while more than half of their peers in the same district are not even proficient (National Center for Education Statistics, 2011). Across states, across districts, and even within districts, public schooling in the U.S. is characterized by heterogeneity. In this thesis, I focus on equity in the largest school district in the country, New York City Department of Education. However, its experiences should be understood in the context of a nationwide discussion about school equity.

In fact, differences in students' educational opportunities and outcomes have sparked interest and concern in the U.S. for centuries. Since at least the 1700s, Americans have petitioned officials for fairer public education.[8] Whether in legislation, through the courts, or in research, members of the public have expressed concern for equity in public education. In its 1954 ruling *Brown v. Board*, the Supreme Court made clear that the Constitution requires that public education, "where the state has undertaken to provide it, is a right which must be made available to all on equal terms." Subsequent rulings and laws at the state and national levels of government have expanded the

[8] See, e.g., "A Petition on Behalf of Black Inclusion in the Boston Common Schools" in Martin 1998, p. 42.

requirements that states must meet in providing public education. For example, the Elementary and Secondary Education Act (ESEA) of 1965 required that the federal government allocate extra funds to districts with “educationally deprived students.” Title I of the law, now known as No Child Left Behind, governs the provision of additional federal funds for educating students living in poverty. The Individuals with Disabilities Education Act (IDEA) sets standards for the quality of educational services that states must provide to students with disabilities. At the state level, the New Jersey Supreme Court’s rulings in the *Abbott v. Burke* cases established that the state was obligated to ensure additional funding for certain school districts based on the costs of educating their higher-need students (Education Law Center, 2011). And in its rulings in *Campaign for Fiscal Equity v. State*, concluding in 2006, New York State’s highest court required the legislature and governor to provide more money to school districts to allow students the opportunity for a “meaningful high school education” (Campaign for Fiscal Equity, 2011).

Multiple states and districts have revised their methods of allocating educational resources. Ohio instituted a new statewide funding method in 2009 (Marshall, 2009). Tennessee’s comptroller last year called for a new, simpler state system (Associated Press, 2011). And in 2010, Baltimore City Public Schools hosted a conference for school districts concerned with strategies for “fair student funding.” New York City Department of Education (NYC DOE) was one of the participants. (Education Resource Strategies, 2012)

NYC DOE’s participation was fitting, since in 2007 it announced the beginning of a new school-funding regime. Decrying the old method of funding its schools as “unfair and hard to understand or explain," NYC DOE promised that the new financing plan, "Fair Student Funding" (FSF), would be phased in gradually in the 2007-2008 and 2008-2009 school years and would make funding fairer for schools across the district. However, in the years since this announcement, only one rigorous study has attempted to gauge the fairness in the system – and it was largely limited to a comparison of only two fiscal years, 2001 and 2008 (Stiefel & Schwartz, 2011). In addition, the intervening recession and 2009 freeze in state funding to New York City's schools cast doubt as to the extent to which reforms were implemented. In sum, it is unclear whether equity for the City's schools has changed at all with the implementation of a "fair" funding system.

Therefore, in this thesis, I ask whether equity in spending across the City's schools has changed since 2008. Though I expect Fair Student Funding to have played a major role in any changes, I do not seek to isolate its effect – rather, I ask whether equity improved overall. In effect, I ask not whether the district's policy changes would have changed equity all else equal, but rather whether, given all exogenous factors, equity did improve for students in New York City in this time period. This is useful not just in light of the recent policy changes in New York City but also because until recently, most literature on school finance equity focused on state financing systems – that is, equity for districts rather than equity within districts. This paper contributes to the growing body of research on New York City specifically and United States school districts more generally.

Methods of Assessing Equity

There are multiple approaches to use when examining the equity of school systems. In this paper, using financial records and performance reports on New York

City's public schools from fiscal years 2003 through 2011,[9] I discuss two classic measures of school-finance equity: horizontal and vertical equity. These were first applied to school districts by Berne and Stiefel (1984) and then developed across subsequent studies.

Horizontal equity requires that if students have equal needs, they must be treated equally. In the context of school finance, horizontal equity would require, for example, that all general education students receive the same baseline level of resources and funding, irrespective of factors like the school they attend. Some studies have simply measured the distribution of spending across students (or a broad group of students, like general education students) as a way of measuring horizontal equity. Because this is a useful way to describe where money is going in a district, I measure the distribution of spending per student across schools in New York City.

However, I do not consider this a horizontal equity test, since testing for horizontal equity would require controlling for student needs. Therefore, I take into account the fact that student needs vary widely within the general education category by testing whether general education dollars were spent in a manner associated with the demographic characteristics of schools (particularly indicators of student need, e.g., poverty). If so, I ask whether that relationship weakened after the Fair Student Funding reforms.

Vertical equity refers to differentiating treatment for differently situated individuals, in response to their differing needs. For example, in the public education setting, it would be considered vertically equitable to provide extra funding for students

[9] Fiscal years 2003 through 2011 correspond to school years 2002-2003 through 2009-2010. I use this notation throughout this paper when discussing New York City.

whose disabilities make it more expensive to educate them. In this paper, I ask whether vertical equity in the City's public schools increased from 2008 onward. I test this by asking whether schools with more high-needs students were likely to spend more on their students – and whether the magnitude or the sign of any such relationship changed after 2007.

I also examine the distribution of student performance on standardized tests across schools, based on the assumption that a vertically equitable school system is one that provides all of its students with the opportunity to achieve. If it is doing so, one might expect student academic achievement to be approximately equally distributed across the district's schools. Using test scores as a proxy for achievement, I examine the dispersion of proficiency rates across schools and test for associations between proficiency rates and demographic characteristics. I also look for changes from 2008 onward.

Looking Ahead

In the following two chapters, I provide the information necessary to understand the context and methodology of this thesis. Then, in Chapter Four, I describe in detail the methodology summarized above. In Chapter Five, I present the results. Notably, I find evidence that a school's percentage of poor, non-white, and Limited English Proficient students was associated with higher spending per student, while a school with more transitory students was likely to spend less. However, there is evidence that spending per student in schools with more transitory students increased dramatically with the implementation of Fair Student Funding. In addition, as expected, a school's percentage of poor, non-white, and transitory students was negatively associated with its test performance overall – though schools with more Limited English Proficient students did not appear to perform worse in math testing. There is little evidence for improvement in test scores with the implementation of Fair Student Funding. Finally, in Chapter Six, I discuss the findings and make suggestions for future work.

CHAPTER TWO: BACKGROUND and LITERATURE REVIEW

In this paper, I examine whether New York City Department of Education's transition to "Fair Student Funding," announced in 2007, was accompanied by an increase in equity of resource allocation within the school district. I look at equity in two different ways: as horizontal equity and as vertical equity. In this section, I describe measures of horizontal and vertical equity. I then examine what is already known about horizontal and vertical equity in school systems across the United States. Throughout the discussion, I consider the equity of the distribution of per-student resources.

Measuring Horizontal and Vertical Equity

Researchers have employed a variety of indicators of horizontal equity and vertical equity. I discuss several of them in turn. First, the Gini coefficient is a measurement of the deviation from absolute equality. It is defined in reference to the Lorenz curve, which displays the relationship between the cumulative proportion of a given population and the percentage of income or other variable of interest (like the percentage of students who pass a standardized test). Each observation is sorted in ascending order (in terms of the variable of interest) and is then plotted. For example, to measure the dispersion of per-pupil expenditure, I rank schools by per-pupil expenditure and plot them in ascending order to construct the Lorenz curve, which is represented by the curve delineating areas A and B in Figure 1. The 45-degree straight line from the origin is the line of absolute equality (where, for example, half of the schools receive half of the resources), so area A represents the difference between the actual distribution of resources and the condition of absolute equality. The Gini coefficient is the ratio of this area A over the sum of areas A and B:

$$(Gini\ coefficient) = \frac{(area\ A)}{(area\ A)+(area\ B)}.$$

(Sen & Foster, 2003, pp. 29-31) Because the Gini coefficient ranges in value from 0 to 1, with 0 representing no deviation from equality – that is, a condition of absolute equality – and 1 representing maximum inequality, it is a natural measure of horizontal equity. It is up to the observer to decide what value of the Gini coefficient represents a sufficiently equitable system, though 0.1 or below is a common standard. The Gini coefficient can also be adapted to test for vertical equity by measuring the evenness of the distribution of student outcomes, since vertical equity requires that schools provide all students with the opportunity to learn.[10]

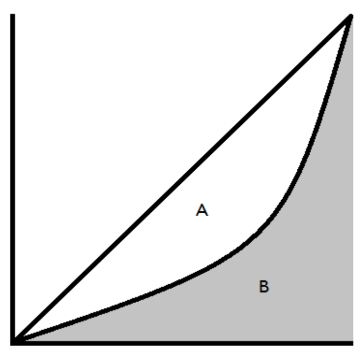

Figure 1. The Gini Coefficient.
The horizontal axis shows the percentage of schools, and
the vertical axis shows the percentage of resource inputs or student outcomes.

Another useful measure of horizontal equity is the coefficient of variation. It is equal to the square root of the variance divided by the mean, where

[10] Such analysis requires a value judgment about what level of achievement all students <u>ought</u> to be able to attain. For example, it might be reasonable to expect a school system to mitigate outside, detrimental effects like poverty to the extent that most students meet at least a basic understanding of taught subjects. However, it might be unreasonable to expect all students to qualify for highly advanced math courses, for example, due to exogenous factors like student ability which the school cannot mitigate. In addition, some might argue that schools should "bring a horse to water, but can't make it drink"; that is, that it is the job of parents and students – not the school – to ensure that students take advantage of educational opportunities that are provided. Therefore, using student achievement as a proxy for opportunity to learn requires caution.

$$(variance) = \sum_{i=1}^{n} \frac{(mean(y_i) - y_i)^2}{n}.$$

Here, y_i indicates the resource level at an individual school i for n number of schools. Scaling the variance by the value of the mean makes it possible to make comparisons across years with different mean values of resources (or outcomes):

$$(coefficient\ of\ variation) = \frac{\sqrt{variance}}{mean(y_i)}.$$

(Sen & Foster, 2003, pp. 27-29) As with the Gini coefficient, I use the coefficient of variation to measure the distribution of per-student expenditures, and I also adapt it to measure the dispersion of student outcomes.

The McLoone index is concerned with equity in observations in only the bottom half of the distribution of resources. Its lack of focus on any students above the median may be perceived as a weakness unless the median resource level is thought to be adequate. The McLoone index can be represented graphically, as in **Error! Reference source not found.**, where schools are plotted along the horizontal axis in ascending order of their resource level (the school with the most resources per student is farthest right on the axis). It is the ratio of the inputs allocated to schools in the bottom half of the resource distribution, compared to the total inputs they would receive if they were receiving the median level of allocations:

$$(McLoone\ index) = \frac{(area\ C)}{(area\ C) + (area\ D)}.$$

The McLoone index varies in value from 0 to 1, with higher values indicating higher levels of horizontal equity. The maximum value of 1 indicates that the bottom half of schools in the resource distribution are receiving equal resources. (Alexander & Salmon, 1995, pp. 237-238) In this paper, I use per-student spending as the resource

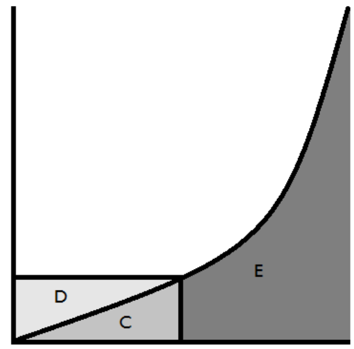

Figure 2. The McLoone Index.
The horizontal axis shows the percentage of schools, and
the vertical axis shows the percentage of resource inputs or student outcomes.

measure. I also adapt the McLoone index for use with student proficiency rates. Each of these measurements of horizontal equity is best suited for comparing relative levels of equity across systems (e.g., school districts) or over time – rather than for determining absolute levels of equity. How equal a distribution must be before a system is considered equitable is a matter of subjective judgment. Numeric standards for equity are arbitrary and may change over time.[11] Therefore, in this paper, I present only numeric values and discuss trends in those values over time, leaving it to the reader to assess the normative acceptability of the values.

Another way to measure horizontal equity is to ask not how equally resources are distributed but whether resources are distributed unequally. In their one-year study of New York City, Iatarola and Stiefel (2003) used a multivariate regression to ask whether student demographic characteristics (including characteristics that indicate need, e.g., poverty status) are correlated with per-student spending. I use this method to measure

[11] For example, Hertert (1996) and Burke (1999) used 0.1 or lower as the standard for an acceptable Gini coefficient, based on the definition provided in the 1992 version of Odden and Picus's textbook. However, in the textbook's latest edition (Odden & Picus, 2008), the standard is revised to 0.05, reflecting the arbitrary nature of deciding how equal is "equal enough." This change underscores the difficulty of making absolute (rather than relative) statements about the equity of a system.

associations between student characteristics and per-student spending as well as test performance.

When measuring equity, it is necessary to determine the unit of analysis. In my dataset, which is a panel of school-level data, the school is an obvious unit of analysis. However, some researchers suggest that when measuring equity, school-level data should be weighted by school enrollment.[12] This has the benefit of preventing very small schools from disproportionately skewing the equity analysis if they affect only a handful of students. I do not weight by enrollment where there is no control for varying student needs (i.e., when using the Gini coefficient, the coefficient of variation, or the McLoone index to describe distributions of outcomes or spending across all general education students). However, since the multivariate regression model introduces a finer-grained view of students (by adding controls for student characteristics at each school), it is less problematic to use student-weighting. I run both unweighted and weighted multivariate regressions. I note whether measures are pupil-weighted or not when interpreting each set of results.

Inputs and Outputs that Matter

When discussing equity in school finance, one must identify "what matters" – that is, what inputs (e.g., dollars per student) or outcomes (e.g., test scores) ought to be equitably distributed among students, schools, or districts. In this section, I examine the literature on this topic. I then discus what is known about how those resources and outcomes are actually distributed.

[12] See Burke (1999) on Gini coefficients.

As is already clear, in analyzing "what matters" in public education, some researchers focus on the equity of the distribution of resources, while others consider student outcomes. It is appealing to examine student educational achievement since it is a direct goal of public education. Though it is unclear whether schools should be judged based on what their students actually learn or based on what opportunities they provide for students to learn (as well as how to measure opportunities), outcomes can still be useful. This is the case in vertical equity analyses in particular, since vertical equity requires that schools at least partially compensate for outside negative factors that otherwise detract from student achievement.

In addition, there is a strong case for examining how funds are distributed within a school system. First, the courts have often focused on the equity of funding rather than of outcomes (e.g., the *Abbott v. Burke* cases in New Jersey (Education Law Center, 2011) or the *Serrano v. Priest* cases in California (Odden & Picus, 2008, pp. 35-38)), and state methods of allocating funds for education generally focus on inputs as well. Second, there is a wide body of literature that suggests that "money matters," i.e., that students' outcomes are in part a function of the fiscal resources dedicated to their education. For example, Hedges, Laine, and Greenwald (1994), reviewing past analyses, found "systematic positive relations between resources" (including per-pupil expenditures) and students' academic outcomes. Card and Krueger (1996) reviewed existing studies and found significant evidence for a positive relationship between spending per student and student outcomes later in life (in the form of earnings in adulthood). Archibald (2006) examined spending levels in a Nevada school district and found that increased instruction-related spending is related to higher reading outcomes for students in grades three through six. While Hanushek (1997) drew different conclusions in his meta-analysis of prior work, finding that there is no clear relationship between school resources and outcomes, Krueger (2003) pointed out that this is due largely to the rather arbitrary manner in which studies were synthesized, with heavier weight unfortunately placed on analyses that used smaller samples of students. I conclude that though major methodological challenges exist – particularly the omitted variables bias that threatens any attempt to draw conclusions about causal relationships from observational data – the literature overall suggests at least some causal relationship between expenditures and outcomes.

In addition to money per se, class size appears to be another important factor in student achievement. For example, Krueger and Whitmore (2001) reviewed data from Tennessee's STAR experiment and found that students who had small classes were more likely to take college-entrance tests. Grissmer (1999) supported the importance of small classes in his survey of prior literature, and Finn and Achilles (1999) noted the particular value of small classes for impoverished students and students in younger grades.

Another important input may be teacher quality, though measuring it is difficult. For example, Kane, Rockoff, and Staiger (2008) found that certification schemes are of limited use in determining the quality of teachers in New York City. Researchers sometimes use teacher experience as a proxy for quality, with some justification. Rice (2003, pp. 16-19) and Clotfelter, Ladd, and Vigor (2007), among others, found evidence that teacher effectiveness increases with time in the classroom. However, it appears that the positive relationship between teacher experience and student learning "level[s] off after 5 years" (National Center for Education Statistics, 2000), limiting the viability of experience as a proxy for quality.

Physical facilities may also affect student outcomes. Some research suggests that their characteristics (including indoor environmental characteristics like temperature and air quality) may affect student performance (e.g., Schneider (2002)). Recent work from Cellini, Ferreiera and Rothstein (2010) provides evidence that homeowners value school facility funding. Using a regression discontinuity model, they showed that a sudden increase in school facilities investment was followed by a rise in home prices, suggesting that this funding was capitalized in home prices.[13] However, Odden and Picus (2008) cautioned that "investments in facilities by themselves are unlikely to improve student learning" (p. 177).

Findings on Horizontal and Vertical Equity

Research on educational resources and outcomes has focused on equity for both schools and districts. Work on school finance equity initially focused on states and whether their systems of school finance produced equitable resource distribution for school districts (for example, Berne and Stiefel (1984); Wyckoff (1992); Riddle and White (1996); Murray, Evans, and Schwab (1998)). This focus on funding to school districts (rather than to schools within districts) is at least partially attributable to data availability (Goertz, 1997), and it is appropriate given that, as described above, states are responsible for the funding formulae that determine how much funding will be available to districts. Not only do states determine how much funding to provide to each district, but they may also determine how much money school districts or localities can collect

[13] Interestingly, they found that increased test scores accounted for only part of the rise in value.

from their tax bases (Mullins & Wallin, 2004). However, a focus on resources distributed to districts cannot capture inequity within districts, as Hertert (1996) showed. Fortunately, an increasing number of studies examine equity within districts on the level of the school.

The evidence on horizontal equity of resources across schools within a single district is mixed. With regard to funding, Hertert (1996) found that while California's method of funding its school districts was "fairly equitable" in 1990-91, its schools experienced significant variation in per-student regular education spending levels within school districts. She found an average Gini coefficient of 0.099 and an average coefficient of variation of 0.1847 within school districts. Riddle and White (1996) observed per-student district-level funding across the United States and found that coefficients of variation for each state varied from values of 0.053 to 0.430 – a huge range. However, they do not control for pupil need, citing limited data, which may help explain the higher end of the coefficient of variation estimates.

Exploring the relationship between allocated resources and need, the National Center for Education Statistics (2000) found that poverty and minority status are correlated with having inexperienced teachers. Given that poverty is often considered an indicator of high need, this may be a direct violation of the principle of vertical equity, which would suggest that these students should have, if anything, more experienced teachers. And though little research is currently available on equity in the distribution of facilities resources (Odden & Picus, 2008), both Lowe (1996) and Arsen and colleagues (2005) found that lower socioeconomic status may be correlated with worse school facilities. However, Glenn and colleagues (2006) cautioned that any relationship between socioeconomic status and infrastructure is not universal.

The degree to which equity exists in class size is also unclear. Burke (1999) examined student-teacher ratios and found that more than 93 percent of the school districts in her 1,204-district sample had “acceptable” levels of inequity across their schools. In this case, Burke refers to a Gini coefficient of 0.1 or lower as “acceptable” but acknowledges that others could reasonably propose a different standard. However, she did not control for factors affecting student need, so it is difficult to tell whether differing student needs were being met in districts with similar student-teacher ratios across their schools. Because of the difficulty in determining what inputs are necessary to provide a quality education to students (to say nothing of the difficulty in determining how much those inputs would cost), vertical equity studies are not plentiful. Existing work on vertical equity has often been commissioned by state governments or other parties interested in changing a state’s system of school finance (e.g., Picus and colleagues (2012)).

In the following chapter, I discuss what is known about New York City, surveying the research and the policy decisions relating to equity within the City’s public schools. Though more research is needed, the preceding literature review suggests that inequities are not uncommon across and within school districts. As I show in the next chapter, the history of NYC DOE suggests at the very least that spending on students was not strongly anchored to student need before Fair Student Funding was announced in 2007.

CHAPTER THREE: NYC DOE and "FAIR STUDENT FUNDING"

Beginning in fiscal year 2008, New York City Department of Education made major changes in its school-funding methodology. NYC DOE reported that the old system had been "unfair" and often provided funds in a manner "unrelated to the needs of the school's current students" (New York City Department of Education, 2007, pp. 5-6). The new funding regime, called "Fair Student Funding" (FSF), promised to make funding more responsive to the needs of students by using need-based weights assigned to each school's students. The system was to be phased in gradually in 2008 and 2009. However, a variety of factors, including political concessions and cuts in state funding, make it unclear how funding actually changed for schools.

Budgeting and Equity before FSF

The pre-2008 funding system was, by NYC DOE's own admission, ineffective and not based on needs. School budgets were divided into state and federal categorical funding (like Title I grants) and funding for general education and special education instructional purposes. Allocations for individual schools were carried over from year to year, with the decisions made sometimes "for legitimate reasons now outdated, sometimes because of politics" (New York City Department of Education, 2007). This led to potentially large inequities, as illustrated in Figure 3.

What literature exists on equity of school funding in New York City before the implementation of FSF confirms NYC DOE's assessment that the system was not fair for students. For example, in an analysis of fiscal year 1998, Iatarola and Stiefel (2003) showed that schools with high proportions of free-lunch-eligible students tended to have lower teacher salaries and lower percentages of highly qualified teachers. This suggests that the city's system of resource distribution placed low-income students at a disadvantage. Intriguingly, however, schools with larger immigrant populations tended to have higher teacher salaries and more highly qualified teachers, suggesting that being "high-need" does not always correlate positively with being "underserved." More generally, Iatarola and Stiefel's evidence suggests that student-teacher ratios, average teacher salaries, and baseline expenditures for various groups of students (low-income, immigrant, etc.) often move together, but not always. Similarly, Rubenstein, Schwartz, Stiefel, and Bel Hadj Amor (2007) found that while a school's racial composition was not associated with expenditure per pupil in New York City in 2000-2001, after controlling for student needs (including poverty level, English proficiency level, and special education level), schools with more black and Hispanic students were less likely to have licensed teachers or teachers with master's degrees or higher.[14]

Most recently, Stiefel and Schwartz (2011), comparing NYC DOE's expenditures in 2001 with expenditures in 2008, found that per-pupil classroom spending was higher in 2008.[15] Their analysis used multivariate regressions of changes in per-student resources (teachers and expenditures) on student demographic and academic need characteristics. They found that the ability of poverty level to explain school allocations did not change over time for elementary, middle, or high schools, and that student needs including reading ability and special education status increasingly explained the variation in expenditures per pupil between 2001 and 2008 for elementary and middle schools. These results suggest that funding was somewhat more equitable in 2008 than it was in 2001, at

[14] One weakness in their analysis is that they include "pass-through" funds as part of total expenditure per pupil at schools. A staff member at NYC DOE cautions against including "pass-through" funds because they do not affect the children to whom they are, on paper, allocated. Including pass-throughs would have the effect of artificially inflating total expenditure per pupil. (Halper, 2012, February 27)

[15] They exclude pass-through funding in this analysis.

least for elementary and middle schools. However, Stiefel and Schwartz addressed neither spending trends <u>between</u> 2001 and 2008 nor spending in 2009 onward, so it is not possible to draw conclusions about the equity of expenditures immediately before and after the beginning of FSF or during its implementation.

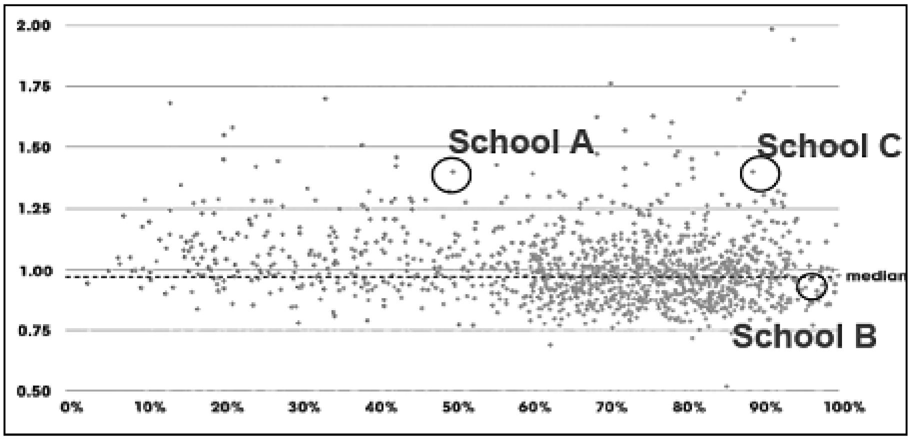

Figure 2. NYC DOE's Demonstration of Inequities in School Funding in 2007.
Each dot represents a school, the horizontal axis shows the poverty rate in the school, and the vertical axis shows the school's Fair Funding Index. A Fair Funding Index of 1.00 indicates that a school was, in 2007, already receiving the funding it would receive if the plan were fully implemented. NYC DOE points out that "School A, with about 50 percent poverty, receives about the same per-student funding as School C, with about 90 percent poverty. School B, which has nearly 100 percent poverty, receives less than both School A and School C." (Graph and text from Section 1.2 of Fair Student Funding guide (New York City Department of Education, 2007))

Implementation of Fair Student Funding

From 1993 through 2006, a non-profit organization called the Campaign for Fiscal Equity brought suit against the State of New York, alleging that the state did not adequately fund its school districts. In 2006, the state's highest court made its final determination, ruling that that the state had to increase its funding for all school districts, including New York City. (Campaign for Fiscal Equity, 2011) In 2008, NYC DOE was slated to receive an additional $939 million in state education funding. This opened up the possibility for the City to increase funding for the least advantaged schools (in terms of per-student funding relative to student needs) without harming other schools. (New York City Independent Budget Office, 2007) Perhaps in light of this opportunity, NYC DOE decided to allocate about two thirds of school budgets through Fair Student Funding in 2008 (New York City Department of Education, 2007, p. 16). NYC DOE planned to use student-level needs-based weighting, whereby each student in the school is assigned a needs score, with students believed to have higher needs assigned higher weights. (The weights assigned to students for 2008 are provided in Table 1.) Based on each school's aggregate score, NYC DOE determined how much funding each school would ideally receive. NYC DOE could then compare each school's current funding level to the level prescribed by the FSF method. (New York City Department of Education, 2007) To borrow the terminology of the New York City Independent Budget Office, based on this comparison some schools were considered "overfunded" relative to their FSF prescriptions, and others were considered "underfunded" (New York City Independent Budget Office, 2007).

Neither "overfunded" nor "underfunded" schools were to see drastic changes right away. NYC DOE planned to implement the new funding scheme gradually in 2008 and 2009. "Overfunded" schools were to continue receiving the same high level of funding for 2008 and 2009 under a "hold-harmless" provision, while "underfunded" schools were limited in the amount of additional money they could receive. In fact, the first group of schools was scheduled to keep their funding levels for at least two years, even while other schools' funding increased only partially. (New York City Independent Budget Office, 2007) While increases in equity may have therefore been limited in the initial implementation of FSF, need appears to have played a bigger role in funding distribution

Table 1. Weights and Dollar Allocations Under Fair Student Funding.
Adapted from the Independent Budget Office's Fair Student Funding Report (New York City Independent Budget Office, 2007), page 4.

Student Characteristic	Weight	$ Per Student
Base Weights		
grade K-5	1.00	$3,788
grade 6-8	1.08	$4,091
grade 9-12	1.03	$3,902
Special Needs Weights		
Academic Intervention		
Entering Before 4th Grade		
In Poverty	0.24	$909
Entering 4th to 5th Grade		
Below Standards	0.25	$947
Well Below Standards	0.40	$1,515
Entering 6th to 8th Grade		
Below Standards	0.35	$1,326
Well Below Standards	0.50	$1,894
English Language Learner		
grade K-5	0.40	$1,515
grade 6-12	0.50	$1,894
No Child Left Behind Transfer		
NCLB Transfer	0.53	$2,000
Special Education		
Less than 20% of Day	0.56	$2,121
20-60% of Day	0.68	$2,576
Over 60% of Day, Self-Contained	1.23	$4,659
Over 60% of Day, Inclusion	2.28	$8,637

in 2008 than it had previously. This is confirmed by the findings of Rubenstein and colleagues (2007), described above. However, it is unknown whether this relationship between student need and funding fell or continued to rise after 2008, for multiple reasons.

First, FSF had been only partially implemented in 2008. It was to be further phased in during 2009, but state budget cuts during the recession that began in 2007 appear to have at least partially waylaid that plan. The City faced cuts in funding from the state in 2009, 2010, and 2011.[16] This may have led to responses that undermined the implementation of FSF. For example, to deal with budget cuts for fiscal year 2010, the DOE planned to cut school budgets by four percent. However, according to the New York City Independent Budget Office, upon realizing that about a quarter of affected schools would face insufficient funding even to operate, NYC DOE essentially reworked the funding method until schools would receive at least 86 percent of their "operating threshold" funding level. (Smith, 2010)

One further source of ambiguity is the availability of federal categorical funds. The Independent Budget Office reports that NYC DOE used federal stimulus funds to minimize the effect of funding cuts on school budgets. Though federal categorical grants come with the requirement that they supplement – not supplant – state and local funds, it is unclear whether they might have been shuffled around at the level of the school to help schools meet their budgetary needs, especially in the face of falling per-pupil allocations from the state in both 2010 and 2011. If they were shifted away from schools with the highest needs in order to ensure that no schools fell below acceptable operating funding levels, it is possible that equity fell as high-needs schools lost dollars intended to benefit their students.[17]

Given changes in the pool of available school funds and in budgeting methods, it is not clear to what degree the district's emphasis on funding based on need has survived. Therefore, overall, it is ambiguous to what degree, if at all, equity in New York City's

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[16] It should be noted that funding per student from the state did not fall from 2008 to 2009, though total allocation did (New York City Independent Budget Office (n.d.)).

[17] Scattered anecdotal evidence supports this possibility. For example, special education class sizes appear to be rising as a result of changes in the FSF methodology, to the concern of some parents (Hampton, 2011).

public schools increased after 2007. In the next chapter, I discuss the methodology that I use to address this question.

CHAPTER FOUR: METHODOLOGY

Constructing the Dataset

To test whether equity changed in New York City public schools after the initial implementation of Fair Student Funding in Fiscal Year 2008, I constructed a dataset including school-level data on elementary and middle schools in NYC. I used four publicly-available sources: NYC DOE's School Based Expenditure Reports (SBER), New York State Report Cards (SRC) for schools, the National Center for Education

Table 2. Variables and Sources.

Variable	Source	Years	Describes which students?
Dependent Variables (School-Level)			
Spending per Student (elementary and middle school)	SBER	2003-2010	General Education students
Proficiency Rates in English Language Arts and Math (fourth and eighth grade)	NYC DOE	2006-2010	General Education students
Covariates (School-Level)			
Percentage of Students in Poverty (percentage whose families receive public assistance, estimated to nearest decile by school)	SRC	2005-2010	Total Enrollment
Percentage of Students who are Limited English Proficient	SRC	2005-2010	Total Enrollment
Percentage of Students who are Transitory (defined as percentage of students in school's highest grade who were not enrolled at any point in the prior year)	SRC	2005-2010	Total Enrollment
Percentage of Students who are Non-White	CCD	2005-2010	Total Enrollment
Percentage of Students who are Designated Special Education	SBER	2003-2010	Total Enrollment

SBER: New York City Department of Education's School Based Expenditure Reports (http://schools.nyc.gov/Offices/DBOR/SBER/OLD_YEARS.htm)
NYC DOE: New York City Department of Education's published test results (http://schools.nyc.gov/Accountability/data/TestResults/ELAandMathTestResults)
SRC: New York State Report Cards for schools (https://reportcards.nysed.gov)
CCD: National Center for Education Statistics Core of Common Data (http://nces.ed.gov/ccd)

Statistics Common Core of Data (CCD) from the U.S. Department of Education, and NYC DOE's published state standardized test results. The SBER dataset includes actual expenditure amounts at the school level, with each expense's function and each school's number of enrolled general and special education students, for fiscal years 2003 through 2010, adjusted to 2008 dollars.[18] These expenditure reports are the most detailed indicator of how each school's funding was used and therefore allow me to isolate funding that was used for general education purposes. The SRC dataset includes demographic information at the school level (including the percentage of students whose families receive public assistance, the percentage of transitory students, and the percentage of students with limited English proficiency) for 2006-2010. The CCD dataset includes each school's racial/ethnic composition for 2006 through 2010. Finally, NYC DOE's test results include fourth-grade and eighth-grade scores on state math and English Language Arts tests for 2006 through 2010. In Table 2, I present all variables and their sources. Table 3 and Table 4 present summary statistics describing school-level spending and test performance.

The dataset includes 764 elementary schools and 493 middle schools for which financial data were available in 2003 through 2010 (including those that were open for only part of that time). I exclude charter schools and schools in NYC DOE's special education sub-district because they were not part of the Fair Student Funding changes. I also exclude special education students (and special education funding) because of their varying needs,[19] and I exclude high schools because New York City is home to a variety

[18] I use the 2008 Consumer Price Index to allow comparability with Stiefel and Schwartz's (2011) study of NYC funding.

[19] Interestingly, NYC DOE designates each student as "general education" or "special education" based on the type of services he or she receives during the majority of each school day. All spending for that student

of high school types (including technical schools and specialty schools) which may vary more significantly in funding needs than the elementary and middle schools. For example, a veterinary training program may require special equipment or a performing arts school may require musical instruments (New York City Department of Education, 2012b); alternate high schools for at-risk students may provide unusually small classes (New York City Department of Education, 2012a).

Table 3. School-Level Per-Student General Education Spending (in 2008 dollars), for Elementary and Middle Schools, 2003-2010.

Year	Mean	Standard Deviation	Schools in Sample
		Elementary Schools	
2003	12,562.04	1,975.34	697
2004	13,260.32	2,035.32	708
2005	13,783.62	1,967.73	634
2006	14,596.50	2,187.72	620
2007	15,160.70	2,481.17	619
2008	15,964.67	2,408.51	615
2009	15,929.86	2,508.10	618
2010	16,557.71	2,528.87	630
		Middle Schools	
2003	11,934.06	2,669.92	217
2004	12,534.01	2,430.46	225
2005	13,640.02	2,598.40	333
2006	14,477.55	2,888.52	365
2007	15,306.09	3,426.22	376
2008	16,111.92	3,533.00	394
2009	16,096.46	3,359.79	403
2010	16,707.95	3,164.98	407

In New York City, it is not uncommon for a single building to house multiple schools (see, for example, Winerip (2011)), and it is important to take this into account

it then tagged as belonging to that student's category. Specifically, if a "general education" student receives $900 worth of general education services and $100 of special education services, the spending is reported as $1,000 in general education spending and $0 in special education spending. (Halper, 2012, March 19) for two reasons. First, building sharing may allow schools to share fixed costs and therefore take advantage of economies of scale in some inputs. Second, since such building sharing arrangements sometimes arose as a result of the Department of Education's focus on small schools under NYC DOE Chancellor Joel Klein after his appointment in 2002 (Rogers, 2009, pp. 23, 54), building sharing may be correlated with specific demographic characteristics. This is because charter schools and smaller high schools were seen as possible alternatives to "failing schools" (Otterman, 2010) or schools with a "failure culture" (Tulenko, 2010), with the replacement schools often being co-located with other New York City public schools.[20] Since the building sharing often resulted from a failing school being replaced, building sharing might be associated both with spending per student (since it would serve higher-need students whose schools are supposed to receive higher funding, e.g., Title I grants) and with omitted variables (like unobserved student need, e.g., neighborhood characteristics). To control both for economies of scale and for possible correlations with neighborhood or school performance characteristics, I would ideally control for whether a school shares a building with another school. Data availability makes this difficult to do with certainty, due to irregularities in the recording of addresses (as well as some missing data),[21] which may explain why, to my knowledge, no prior research on school equity in New York City has addressed this issue. However, a crude test (looking for identical address entries) indicates that, for example, 196 schools were sharing an address with at least one other

[20] See, for example, NYC Coalition for Educational Justice (2010).

[21] I did exclude one school for which per-student expenditures had been so small that it raised concern that the so-called school was sharing very substantial costs with another school. An email from a staff member at NYC DOE confirmed that for 2006 onward, it "was considered a 'program or subschool' which was folded into" another school (Halper, 2012, February 27). I therefore removed it from the dataset.

school in 2010.[22] I therefore include in the multivariate analyses a "duplicate address" dummy variable indicating whether a school shares an address with another school to take building sharing into account.

Table 4. School-Level Proficiency Rates for English Language Arts and Math, for Elementary and Middle Schools, 2006-2010.

Year	Mean English Language Arts Proficiency Rate	Schools in Sample Reporting English Scores	Mean Math Proficiency Rate	Schools in Sample Reporting Math Scores
Elementary Schools				
2006	66%	587	77%	587
2007	63%	590	81%	590
2008	69%	583	86%	583
2009	76%	582	90%	582
2010	52%	581	64%	581
Middle Schools				
2006	43%	274	45%	275
2007	49%	316	52%	317
2008	47%	346	65%	348
2009	63%	366	77%	367
2010	41%	379	49%	379

Dependent Variables

As described in Chapter Two, previous studies have considered a number of variables in measuring horizontal and vertical equity, including student educational outcomes, expenditures, student-teacher ratios, teacher quality (for example, using teacher experience as a proxy), and the quality of physical facilities. I focus on two of these: expenditures and educational outcomes.[23] Expenditures are an appropriate

[22] I checked whether schools shared an address with any other school included in the NYC SBER databases for each year, which took into account the possibility that an elementary or middle school might have shared space with, for example, a high school or pre-school.
[23] I also have data on the total number of teachers a school employs and its total number of students. This would allow me to calculate each school's student-teacher ratio. I choose not to focus on this ratio,

measure because they are a major focus of school funding plans. I focus on total general education spending per general education student.[24] In addition, the data on student outcomes allow me to see whether student achievement – the ultimate goal of spending regimes – changed after the implementation of Fair Student Funding. For math and English Language Arts tests for grades four and eight, I observe the percentage of tested general education students in a school who score in various ranges as well as the mean score at each school. It must be noted, however, that test scores are probably partially a function of a student's cumulative educational opportunities,[25] so, unlike spending amounts, school districts may not be able to affect them meaningfully in the shorter term. Given that Fair Student Funding was implemented in 2008 – and then only partially – and test score data are available only through the past school year (fiscal year 2011), a change in test scores must be interpreted cautiously. It is possible that Fair Student Funding and other contemporaneous factors have changed student learning in a way that will not be perceptible for several years.

Covariates

The covariates include the demographic variables described in the first section of this chapter. The main covariates can be divided into three categories. The first is "need variables," which clearly indicate student need. For each school in each year, I use an indicator of poverty (the approximate percentage of students whose families receive

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however, because the data do not distinguish between general and special education teachers. Grouping general and special education students together to produce an overall student-teacher ratio would be problematic, even after controlling for the percentage of special education students in a school, because of the varying staffing needs of special education students.

[24] At the recommendation of a staff member at NYC DOE, I do not include funds that the DOE categorizes as "pass-throughs," which appear on school expenditure reports but are used for other purposes (e.g., charter school funding) (Halper, 2012, February 27).

[25] See, for example, work on the education production function by Krueger (1999).

public assistance[26]), the school's percentage of students who have limited English proficiency, and the percentage of students who are transitory.[27] These variables are of particular interest because vertical equity requires that where student needs are higher, schools must compensate for these needs in order to offer all students the opportunity to learn. Often this takes the form of additional student funding (e.g., Title I funding).

The second category of covariates is student racial characteristics for each school in each year. I separate this from the need variables because, controlling for student need, horizontal equity requires that students be treated equally regardless of race. The limitation of this method is that I cannot actually control for all student need due to data availability (not to mention the problem of identifying all factors that constitute need). Especially given that the percentage of non-white students is positively correlated with each of the need factors for which I do have data (see Table 5), it is likely that it is also correlated with other, unobserved need variables and can thus be treated, for this analysis, as a proxy for need as well.

Table 5. Correlations between Percent Non-White and "Need" Indicators.

"Need" Indicator	Correlation with Percent Non-White
Percent Whose Families Receive Public Assistance	0.7315
Percent Limited English Proficient	0.2102
Percent Transitory	0.0201

[26] The percentage of students eligible for free or reduced-price lunch and the school's Title I eligibility status are more common indicators of poverty in the literature. However, the CCD data for New York City, which include Title I eligibility status and free and reduced-price lunch information, are plagued by enough missing values to make their use prohibitive. Therefore, I use the far more consistently available public-assistance measure as a proxy for school-level poverty among students.

[27] A school's percentage of transitory students is defined in the SRC dataset as the percentage of students in the school's highest grade who were not enrolled during the previous year. I include this variable due to evidence that suggests that transitory students may have lower academic achievement than non-transitory students (e.g., Rumberger and colleagues (1999)).

The final category of covariates is the percentage of the student body comprised of special education students for each school in each year. It is not clear that a school's percentage of special education students should affect expenditures or test scores for general education students in New York City's public schools. However, substantial literature on the crowding-out of intergovernmental grants – like the federal and state funding that NYC DOE receives for its special education students – suggests that a portion of a school district's special education dollars might spill into general education expenditures.[28] Therefore, I include each school's percentage of special education students to control for this possibility. Controlling for special education status allows me to compare per-student general education spending between schools with comparable populations of special education students.

Distribution of Per-Student Expenditures

To measure the distribution of expenditures across schools in the City, I use the Gini coefficient, the coefficient of variation, and the McLoone index, which are described in detail in Chapter Two. These may be considered appropriate measures of the degree to which schools are treated equally,[29] since I do not weight schools by enrollment – that is, I treat the school, not the student, as the unit of analysis.[30] I calculate these values for

[28] See, for example, the discussion by Smart (2007) describing how standard theory predicts that federal categorical grants earmarked for specific purposes should be treated no differently at the state or local level than funds from tax revenues. While there is some empirical evidence against the crowd-out phenomenon (e.g., Knight (2002)), it appears that general education spending does sometimes rise with special education grants. Of particular note is a 2009 Government Accountability Office study (United States Government Accountability Office, 2009, pp. 56-62) that found that some school districts opted to use legal provisions allowing them to shift special education funds to general education purposes (Chaker, 2010); while not crowd-out per se, it is important to be aware of this and similar possibilities.

[29] Iatarola and Stiefel (2003) refer to the equal provision of funds regardless of need as "equal opportunity"; I prefer the term "equal treatment."

[30] I chose to use the school as the unit of analysis instead of weighting each school by enrollment (in an attempt to make the student the unit of analysis) to avoid producing estimates of equality that are systematically skewed. Specifically, for dispersion measures, weighting by student tends to produce

each school's general education spending per general education student in each year.[31] However, an important shortcoming of these measures is that they do not account for student need, which I address in the following section.

Multivariate Regressions: Per-Student Expenditures and Test Results

I perform several regressions to test for equity, but the general form is the same:

$$(dependent\ variable)_{it} = \alpha + \beta(post\ dummy)_t + \gamma_1(demographics)_{it} + \gamma_2(special\ education)_{it} + \delta_1(demographics)_{it}(post\ dummy)_t + \delta_2(special\ education)_{it}(post\ dummy)_t + \varepsilon_{it},$$

where i and t index school and year, respectively; α is an unknown constant to be estimated, the β, δ, and γ terms are unknown coefficients to be estimated; *dependent variable* is a measure of either general education expenditures per student or test results; *post dummy* is a dummy variable that equals 1 from 2008 onward and equals 0 otherwise (or, in the case of test scores, equals 1 in 2010 and equals 0 for all prior years, since 2010 is the latest year for which demographic and test score data are consistently available); *demographics* is a vector representing the student demographic covariates described above (including need and race); *special education* is the percentage of the school's enrollment comprised of special education students; and ε is an error term.

I run this regression separately for elementary and middle schools. For each, I run two sets of regressions, one regressing per-student spending and the other regressing test performance. For each set, I use both a student-weighted and an unweighted model. For

overestimates of equality, since it requires assigning each student in a school identical per-student spending values.

[31] For the Gini coefficient and the coefficient of variation, I used a module for STATA called ainequal, available through the Boston College Statistical Software Components archive (SSC). For the McLoone index, I wrote the calculations myself.

the regressions of spending, I also test whether including more precise "post dummies" (for years 2008, 2009, and 2010) changes the analysis.

Dispersion of Test Outcomes

The final test that I perform is a variation on the multiple-regression using standardized test outcomes as the dependent variable. As described in Chapter Two, the Gini coefficient, coefficient of variation, and McLoone index are measures of how equally resources or outcomes are distributed across entities (in this case, schools). By using them to observe the distribution of general education students' proficiency among schools, I adapt them to measure vertical equity. The motivation is that vertical equity requires schools to treat differently-situated students differently such that they all have the opportunity to learn. Therefore, one measure of vertical equity, at least for general education students, is the degree to which the percentage of proficient test scores are evenly distributed across the school system's general education students. As described previously, this measure is difficult to use as an indicator of the absolute degree of vertical equity, since even if a school provides the opportunity to learn, it is not necessarily the case that students will all learn equally. However, assuming that outside factors do not systematically change during the time period examined, they can be treated as fixed effects, making the <u>change</u> in the distribution of test scores a helpful way to observe changes in vertical equity. For this measure, I use the Gini coefficient, the coefficient of variation, and the McLoone index. I use unweighted values for reasons described in Chapter Two, which means that the analysis examines the distribution of student proficiency not across students but at the school level.

CHAPTER FIVE: RESULTS

Distribution of Per-Student Expenditures

I first describe the dispersion of spending per student across schools using the McLoone index, coefficient of variation, and Gini coefficient. I divided the schools into elementary and middle schools for the purpose of this analysis, but I did not otherwise account for student characteristics in the model. That is, this analysis implicitly treats all students as equal and does not acknowledge differences in student needs, describing the distribution of general education spending per general education student across schools within the district. Table 6 and Table 7 show the values of the Gini coefficient, coefficient of variation, and McLoone index for per-student spending in elementary and middle schools, respectively, from 2003 through 2010. The results are also presented graphically in Figure 3 and Figure 4.

Table 6. Measures of Dispersion for Per-Student Spending across Elementary Schools, 2003-2010

Year	McLoone Index	Coefficient of Variation	Gini Coefficient
2003	0.098	0.183	0.094
2004	0.101	0.168	0.087
2005	0.096	0.151	0.080
2006	0.102	0.162	0.080
2007	0.097	0.171	0.084
2008	0.099	0.163	0.083
2009	0.099	0.162	0.082
2010	0.075	0.141	0.074

Table 7. Measures of Dispersion for Per-Student Spending across Middle Schools, 2003-2010

Year	McLoone Index	Coefficient of Variation	Gini Coefficient
2003	0.120	0.245	0.116
2004	0.118	0.195	0.102
2005	0.135	0.204	0.105
2006	0.125	0.233	0.111
2007	0.119	0.243	0.109
2008	0.125	0.259	0.110
2009	0.126	0.208	0.107
2010	0.113	0.193	0.098

As discussed in Chapter Two, benchmark "equity thresholds" for these indices are difficult to define. For example, in their latest textbook, Odden and Picus (2008) describe a Gini coefficient of lower than 0.05 as being desirable – a standard the values in my sample do not meet. However, as described in Chapter Two, others have suggested that the Gini coefficient should be 0.1 or lower, a standard which these values do meet. It is much more straightforward to compare changes across districts or over time. These values are comparable to those found in other school systems (e.g., Hertert (1996) found an average within-district Gini coefficient of 0.099 and an average within-district coefficient of variation of 0.1847, which are similar to the values that I found). To compare the values in New York City across time (before and after the implementation of Fair Student Funding), I regressed each measure on a dummy variable that equals 1 for observations from 2008 onward and 0 otherwise, using separate regressions for elementary and middle schools:

$$(dispersion\ measure)_t = \alpha + \beta(time\ dummy)_t + \varepsilon_i.$$

The results confirmed that there was no statistically significant difference in any of the three indicators in 2008 onward. This indicates that the dispersion of spending per student at the school level did not change significantly with the implementation of Fair

Student Funding. If equity is considered to be only the provision of identical resources to students or schools, then this analysis suggests that equity did not change overall in New York City's public schools. However, as described above, I did not take into account student needs (beyond examining only general education students and dividing elementary and middle school students for separate analysis). Therefore, in the next section of this chapter, I incorporate student needs into the model.

Figure 3. Dispersion of Spending per Student across Elementary Schools, 2003-2010

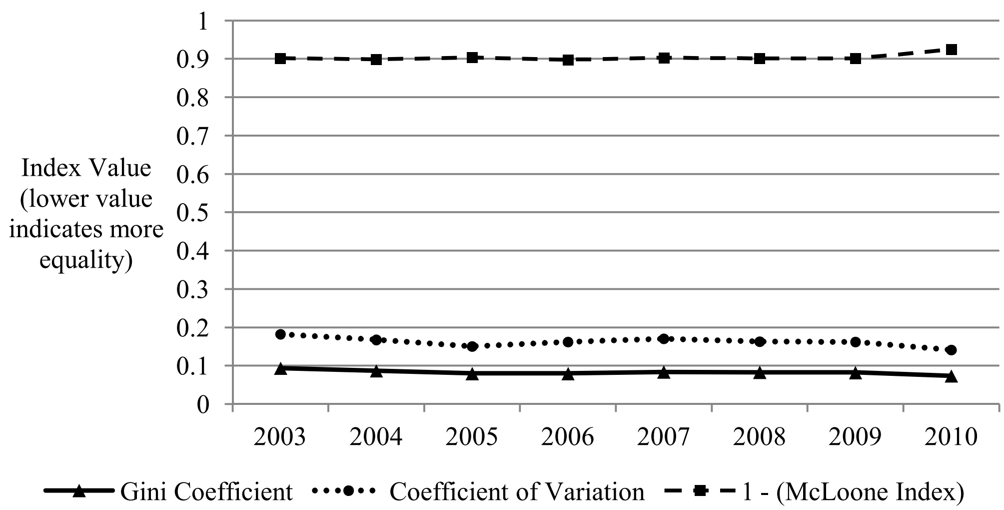
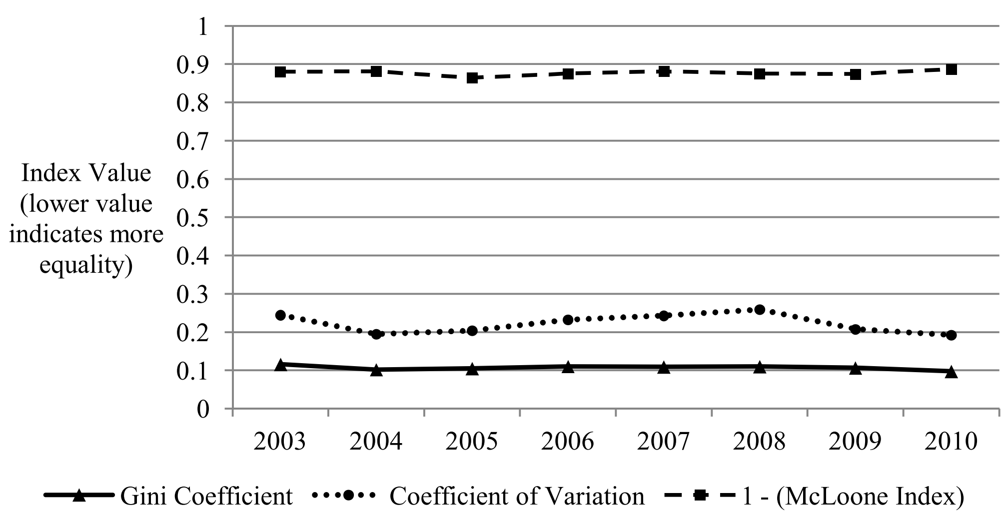


Figure 4. Dispersion of Spending per Student across Middle Schools, 2003-2010



Multivariate Regression: Per-Student Expenditures

For the elementary and middle school samples, I ran two separate regressions. In each, the data represented years 2005 through 2010. For each set, I ran both a weighted and unweighted model. Because the results were very similar, I present only the results from the weighted version.

Elementary Schools: Basic Model

I present the Elementary School results in Table 8. The basic model (column 1) is a regression of the school-level general education expenditures per general education student on school-level demographic characteristics (the percentage of students in poverty, the percentage who are Limited English Proficient, the percentage transitory, the percentage who are non-white, and the percentage of students who are considered special education). The regression also included a control for building sharing.[32] While the coefficient is negative on transitory students, the coefficients are positive on four out of five of the demographic coefficients (percentage in poverty, percentage with limited English proficiency, percentage non-white, and percentage classified as special education). This suggests that if a school's population included relatively more students with these demographic characteristics, more money was spent on its general education students, with poverty (measured by the percentage of students whose families receive public assistance) having the largest coefficient.[33] In addition, an F-test confirmed that

[32] At first glance, it appears to have a much larger effect than the other variables. This is because it is a binary variable (taking values 0 or 1), while the other variables are percentages (taking values 0 through 100) and is simply a result of the way in which the variables were defined.
[33] The coefficient on poverty could be interpreted as indicating that for every one-percentage-point increase in students living in poverty, expenditures rose by almost $17 per student. For reference, in 2008, the average school size was just under 600 and the average poverty rate was about 80%. In such a school, the introduction of six new impoverished students would, all else equal, be associated with approximately a $17-per-student rise in general education spending, or about $10,000 dollars.

the coefficients on the proxies for need (poverty, Limited English Proficient, transitory students, and non-white) are jointly significant (p<0.0001), suggesting that as student need increased, spending per student increased. This makes sense from a vertical-equity point of view.

Table 8. Per-Student General Education Expenditures in Elementary Schools, 2005-2010, student-weighted.

Variable	(1) Basic Model	(2) Interacted Model
Dummy for Fair Student Funding (1 if 2008 onward, 0 otherwise)		365.4 (266.1)
Percent whose Families Receive Public Assistance	16.58*** (2.712)	13.50*** (4.150)
Percent Limited English Proficient	3.564 (2.751)	5.962 (4.401)
Percent Transitory	-9.428*** (0.801)	-4.660*** (0.982)
Percent Non-White	8.511*** (2.253)	10.26*** (3.314)
Percent Special Education	114.5*** (7.721)	85.69*** (11.43)
Shares Building with other School(s)	1,275*** (129.7)	1,201*** (128.1)
(FSF Dummy) * (Receiving Public Assistance)		7.521 (5.200)
(FSF Dummy) * (Limited English Proficient)		-6.045 (5.643)
(FSF Dummy) * (Transitory)		25.75*** (4.773)
(FSF Dummy) * (Non-White)		-6.029 (4.235)
(FSF Dummy) * (Special Education)		16.91 (14.95)
Constant	12,135*** (136.5)	11,815*** (204.6)
Observations	3,105	3,105
R-squared	0.231	0.269

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Because of the high correlation between the jointly significant demographic coefficients, it is difficult to discuss each indicator individually. It is worth noting, however, that the coefficient on race is individually statistically significant and positive, which is probably due in large part to the likelihood that race was correlated with unobserved need variables, as described in Chapter Four. These may include characteristics that I could not observe but that the school district may have been able to observe.[34] It is also interesting that only one coefficient is estimated to be negative: the coefficient on the percentage of transitory students.[35] There are multiple mechanisms that might explain this; each one merits further study. The first is that influxes of transitory students[36] were simply not fully accounted for in the budgeting process, which was partially dependant on the student counts from the prior year. For example, NYC DOE issues dozens of "School Allocation Memoranda" (SAMs) for each school year, introducing basic allocations and then revising them as budgetary, enrollment, and other factors change. The process must begin before it is certain how many "new" students will be enrolled in each school. This planning difficulty may help explain the apparent "under-spending" of schools with more transitory students.[37] Another possible mechanism is that schools with relatively low stability in their student bodies may draw from neighborhoods with relatively low stability. If these communities therefore have lower political clout, political decision-makers may find spending for their schools to be a lower political priority. The negative relationship between spending and transitory

[34] For example, schools know more about student performance histories, which are supposed to be considered in the Fair Student Funding formula. In addition, the district may have allocated different types of after-school, counseling, and other supplementary programs to different schools based on student needs like parental or neighborhood income, which are not included in my model.

[35] The coefficient is still estimated to be negative when the poverty and Limited English Proficient covariates are excluded from the regressions. This suggests that the coefficient on percent transitory is not merely a result of "over-controlling" for highly correlated need variables.

[36] Again, transitory students are defined as the percentage of students in a school's highest grade who were not enrolled in the school at any point in the previous year.

[37] For example, the first SAM for fiscal year 2006, published in May of 2005, indicated that "All school budgets for SY 2005-2006 will be maintained at current year levels *except to reflect changes in general and special education registers*, changes in average teacher salary, elimination of one time allocations, or adjustments and increases in funding to support mandated special education service" (emphasis added) (Feig, 2005). Other SAMs are available online at http://schools.nyc.gov/Offices/DBOR/AM/default.htm.

students should be noted, especially given that transitory students may generally have needs warranting <u>more</u> spending rather than less, as discussed in Chapter Four.

The third estimate that requires discussion is the coefficient on the percentage of special education students. The positive and statistically significant coefficient, which is also larger than any of the coefficients on the other demographic characteristics, is worth noting. This value approximates the effect of a school's percentage of <u>special education</u> students on <u>general education</u> spending divided across <u>general education</u> students. It seems natural to assume that these values should be unrelated to each other. It is certainly possible that the percentage of special education students was associated with some need variable that is unobserved in the regression model; this might explain the positive coefficient. However, as described in Chapter Four, even with a complete and perfect regression model, there are multiple reasons that the relationship might be positive. For example, perhaps special education funds were diverted at the school level to general education functions despite the fact that such funds are generally supposed to "supplement, not supplant" existing dollars (United States Department of Education, 2005). Another possibility is that because NYC DOE's method of coding spending for its school-level expenditure reports requires staff members to divide all expenditures (including overhead costs) across general education and special education students), some coding errors may take place. The apparent anomaly may also be partially explained by the binary nature of the "special education student" designation. Though students are defined as either special education or general education in New York City based on the type of services (special or general) they receive for the majority of the school day, a student categorized as general education could spend 40% of his school day receiving special education services, which would be reported part of "general education" expenditures. If schools with many special education students were also more likely to serve many "nearly special education" students (e.g., a "general education" student spending 40% of his or her school day receiving special education services), then money spent on "general education" students, which includes dollars spent on those students' special education services, might be higher. (Halper, 2012, March 12)

The fourth alternative is perhaps most appealing as an explanation. When overhead expenditures (like a vice principal's salary) are recorded, the spending is divided evenly across general education and special education students (Halper, 2012, April 3). However, perhaps in determining how much money to spend on a resource shared between special and general education students (e.g., a vice principal's salary) for a school, the total pool of available money (e.g., the x dollars per student for the general education students and the y (> x) dollars per student for the special education students) was considered. If schools with higher proportions of special education students could retain administrators with higher salaries and then divide the cost evenly across general and special education students for expense report purposes, the reports would make it look as if general education students were benefiting from more funds because of the extra "buying power" afforded by the special education students.[38]

Finally, the coefficient on the building being shared is positive. This may indicate that schools that shared space also faced higher costs. For example, there may be a systematic relationship between school need and building sharing, as explored in Chapter Four, such that spending would also be associated with building sharing, independent of

[38] I owe many thanks to Elias Sanchez-Eppler for suggesting this possibility.

any economies of scale benefits. The significant coefficient on this term suggests that some variables associated with spending per student are omitted from the model.

Elementary Schools: Interacted Model

The main question I seek to answer is whether equity changed with the introduction of Fair Student Funding, and therefore I estimated an interacted model (column 2 of Table 8), which introduces coefficients that compare pre-Fair Student Funding relationships to those that existed from 2008 onward.[39] Interestingly, the coefficients on the non-interacted demographic and special education variables do not change in either sign or significance compared to the estimates in the basic model, and the magnitudes are also very similar. The <u>interacted</u> demographic variables are jointly significant ($p<0.01$), though only the coefficient on the transitory interaction term is individually statistically significant ($p<0.01$). It is positive, suggesting that per-student spending rose in schools with more transitory students with the implementation of Fair Student Funding. It is also far larger in magnitude (25.75) than the non-interacted transitory coefficient (-4.66), suggesting that the relationship between the percentage of transitory students and per-student spending became <u>positive</u> after Fair Student Funding.[40] This is somewhat surprising since transitory students do not receive more weight than their "stable" peers according to the Fair Student Funding method. It is unclear by what mechanism this change arose, and it warrants future study. Perhaps it is due in part to "transitory" students being more likely to have low academic achievement, which would result in their being weighted more highly under Fair Student Funding.

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[39] I tested a model including time fixed effects for each year of Fair Student Funding (2008, 2009, and 2010); very little differed in the results, so I do not present them here.

[40] A simple regression without interaction terms for only the years with Fair Student Funding confirms that the new coefficient is about 20.99 ($p<0.01$).

Since I cannot observe individual student achievement, this would not appear in the model, so percent transitory may be functioning as a proxy for low achievement or other characteristics.

The other interaction terms do not have statistically significant coefficients. It is, however, interesting that the coefficient on the interaction terms for poverty is positive (suggesting that spending per student in higher-poverty schools may have risen), while the coefficients on the interaction terms for Limited English Proficient and non-white are negative. Race is not included as a category for student weighting in the Fair Student Funding method, so a decrease in the relationship between race and spending is not necessarily surprising. However, if race in this model is serving as a proxy for other student needs, as described previously, then it may indicate that schools with higher-needs students were also spending less per student, all else equal. In addition, a decrease in the relationship between per-student spending and the percentage of students who are Limited English Proficient, which is included in the Fair Student Funding weighting scheme, would be somewhat surprising, though again, the coefficient is small and not statistically significant. Finally, the special education interaction term is positive, suggesting that the relationship between special education students and general education spending may have increased with Fair Student Funding. It is unclear why this might be have occurred; a possibility is that, since Fair Student Funding partially coincided with the onset of the recent recession (and a freeze in state funding), the City found it more appealing to divert special education dollars to general education purposes. However, there is no strong evidence that this is the case, and given the myriad possible mechanisms by which a change could occur, future research would be very valuable.

Middle Schools: Basic Model

The basic model for the middle school sample (shown in column 1 of Table 9) produces estimates that are overall similar to those for the elementary school sample. There are two exceptions. The first is that while the coefficient on the percentage of Limited English Proficient students is positive, as in the elementary school estimates, for middle schools it is also significant ($p<0.01$) and of a larger magnitude than the coefficients on all but the percentage of special education students. The other exception

Table 9. Per-Student General Education Expenditures in Middle Schools, 2005-2010, student-weighted.

Variable	(1) Basic Model	(2) Interacted Model
Dummy for Fair Student Funding (1 if 2008 onward, 0 otherwise)		-72.58 (461.7)
Percent whose Families Receive Public Assistance	18.66*** (4.126)	17.43*** (6.041)
Percent Limited English Proficient	34.36*** (5.043)	35.81*** (7.383)
Percent Transitory	-9.636*** (1.146)	-6.145*** (1.468)
Percent Non-White	1.575 (3.251)	2.345 (4.540)
Percent Special Education	171.6*** (9.953)	123.4*** (19.03)
Shares Building with other School(s)	1,265*** (102.6)	1,219*** (102.5)
(FSF Dummy) * (Receiving Public Assistance)		4.717 (8.046)
(FSF Dummy) * (Limited English Proficient)		-7.513 (9.775)
(FSF Dummy) * (Transitory)		21.03*** (4.385)
(FSF Dummy) * (Non-White)		-2.149 (6.139)
(FSF Dummy) * (Special Education)		45.94** (22.48)
Constant	11,039*** (234.5)	10,983*** (340.0)
Observations	1,954	1,954
R-squared	0.332	0.352

Robust standard errors in parentheses: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

is that the coefficient on non-white is not statistically significant in this basic model (though, as for elementary schools, it is estimated to be positive).

Middle Schools: Interacted Model

In the interacted model (column 2 of Table 9), the coefficients on the non-interacted variables are the same in sign and significance as they were in the basic model. The coefficients on the interacted variables are of particular interest, and, as in the elementary school sample, poverty was positively – but not significantly – associated with more spending under Fair Student Funding. Having more transitory students was associated with a statistically significant increase in spending under Fair Student Funding. Interestingly, the coefficient on the special education interaction term is not only positive – as in the elementary sample – it is also statistically significant at the 95% confidence level and of a magnitude twice that of the coefficient on the percentage transitory interaction term. This suggests that having more special education students in a school was associated with even more spending per general education student under Fair Student Funding than previously.[41] There are multiple possible explanations, as discussed in the Elementary School section above.

Multivariate Regression: Test Results

To determine whether any associations between test scores and demographic characteristics changed with the implementation of Fair Student Funding, I regressed each school's percentage of students testing proficient on various need characteristics and terms interacting need characteristics and a time dummy. Unlike in the multivariate regression of spending, I did not interact the characteristics with a "Fair Student Funding"

[41] As for the elementary school regression, I tested a model including time fixed effects for each year of Fair Student Funding (2008, 2009, and 2010); very little differed in the results, so I do not present them here.

dummy that equals 1 for years 2008 onward and 0 otherwise. Doing so would allow me to test whether the relationship between proficiency rates and demographic characteristics was different in 2008 onward than it was before 2008. Instead, because changes in proficiency rates are likely to lag behind changes in resource provision (like spending patterns), I test only whether proficiency rates were different in the latest year that data are available, which is 2010.[42] Even so, changes in proficiency rates may be only partially perceptible – and indeed, any changes observed are tiny. I summarize each regression in turn. For each regression, I ran both a weighted and an unweighted model. Because of the similarities of the results, I present only the results from the weighted version.

Grade 4 English Language Arts: Basic Model, Interacted Model

The estimates in the basic model (column 1 of Table 10 below) reveal a negative overall relationship between the percentage of high-need students in a school and the school's general education proficiency rate for the fourth-grade English Language Arts test. Specifically, the coefficient on each of the demographic indicators is both negative and highly significant ($p<0.01$). It is unsurprising to find negative relationships between school proficiency rates and factors considered to be need indicators (including race, which, as described above, may act as a proxy for unobserved needs in this regression model). However, it is worth noting that the coefficient on percent special education is statistically significant and negative – suggesting that a school's ratio of <u>special education</u> students was negatively associated with the proficiency rate of its <u>general education</u> students. This may be partially explained if, as explored above, schools with high

[42] While test scores are available for 2006 through 2011, no reliable demographic variables are available beyond 2010, so I limit the scope to 2006 through 2010.

proportions of designated special education students also had high proportions of "barely general education" students (i.e., general education students receiving high levels of special education services). Since these students' test results would be included as "general education" results, if the proficiency rate was lower among these nearly special education students, this would lower the general education proficiency rate.

The interacted model (Column 2) tested for changes in the relationship between proficiency rate and the demographic coefficients. None of the coefficients on the non-interacted covariates differ in sign or significance from the estimates in the basic models. Interestingly, schools with high proportions of Limited English Proficient students may have had higher proficiency rates in English in 2010 than in the prior years ($p<0.1$). However, while the coefficients on the interaction terms for the percentages of students living in poverty, transitory students, non-white students, and special education students are somewhat similar in magnitude to the estimate of the coefficient on the Limited English Proficient interaction term, they are negative in sign. This suggests that these characteristics may have been associated with lower proficiency rates in English in 2010 than in the prior years (though only one is significantly different from zero: the interaction term on transitory students ($p<0.01$)).

Grade 4 Math: Basic Model, Interacted Model

The patterns in the regressions of fourth-grade math proficiency rates (Columns 1 and 2 of Table 11 below) are very similar to the patterns in the fourth-grade English Language Arts proficiency rates, with one major exception. For math, proficiency rates were not statistically significantly associated with a school's percentage of Limited English Proficient students. This makes intuitive sense, given that English language ability is probably more directly necessary for an English Language Arts test than for a math test. In addition, though Limited English Proficient students are not always tested with these New York State tests (New York State Education Department), the difference in association between Limited English Proficient students and proficiency rates might also be linked to peer effects. Specifically, it is possible that if Limited English Proficient students were integrated into English Language Arts classrooms without proper support, they may have inadvertently imposed costs on other students, whose teachers may have needed to change the pace of teaching. The pattern seen here might have arisen if this effect were stronger for English Language Arts than for math.

The interacted Limited English Proficiency coefficient is positive but not statistically significantly different from zero, and it is the smallest of the estimated coefficients on the interaction terms. The transitory interaction term is negative and statistically significant ($p<0.01$), as are the interaction terms on non-white ($p<0.01$) and poverty ($p<0.1$), which suggests that schools with more transitory, non-white, or poor students had slightly lower proficiency rates in math in 2010 than they had previously. However, with such a small "post" sample size (using results from only 2010), it is difficult to make strong conclusions about the patterns observed.

Grade 8 English Language Arts: Basic Model, Interacted Model

The estimates of English Language Arts proficiency rates in the basic eighth-grade model (Column 1 of Table 12) are identical in sign and significance to those for in the basic fourth-grade model. In the interacted model (Column 2), the demographic coefficients are all statistically significant ($p<0.01$) and negative as well. The estimated coefficients of the interacted terms are somewhat some different relative to the fourth-grade model. As in the fourth-grade sample, the percentage of Limited English Proficient students became more likely in 2010 than previously to be associated with English Language Arts proficiency rates. In addition, a school's percentage of transitory students became further associated with low proficiency rates; the coefficient on the percent transitory interaction term has the largest magnitude of any of the interaction coefficients and is significant at the 95% level. As at the fourth-grade level, neither poverty nor race was statistically significantly differently associated with proficiency rates in 2010. The relationship between percentage special education and proficiency rate also appears not to have changed in 2010.

Grade 8 Math: Basic Model, Interacted Model

Finally, the eighth-grade math proficiency rate is negatively associated in the basic model (Column 1 of Table 13) and the interacted model (Column 2) with all of the non-interacted demographic indicators except the percentage of Limited English Proficient students. This pattern was also observed in the fourth-grade math model, suggesting that the percentage of Limited English Proficient students in a school does not affect that school's math proficiency rate.[43] Of the coefficients on the interaction variables, only the one for the race interaction term is statistically significant (and with only 90% confidence). It is negative, suggesting that schools with more non-white students were more likely to have lower proficiency rates in 2010 than they were previously. (Even before 2010, they were still more likely than other schools to have lower proficiency rates: specifically, a one-percentage-point increase in the percentage of

[43] However, the one notable difference between the weighted and unweighted specifications is that in the unweighted model, the school proficiency rates for eighth-grade English Language Arts were statistically significantly <u>negatively</u> associated with the percentage of students with limited English proficiency. Therefore, this finding should be considered only cautiously.

non-white students in a school was associated with more than a quarter-percentage-point decline in student proficiency rate, all else equal.)

Table 10. Proficiency Rates: Fourth-Grade English Language Arts Test, 2006-2009 versus 2010, student-weighted.

Variable	(1) Basic Model	(2) Interacted Model
2010 Dummy (1 when year is 2010, 0 otherwise)		-4.673** (2.361)
Percent whose Families Receive Public Assistance	-0.254*** (0.0213)	-0.251*** (0.0211)
Percent Limited English Proficient	-0.0770*** (0.0254)	-0.0789*** (0.0254)
Percent Transitory	-0.0314*** (0.00712)	-0.0524*** (0.00703)
Percent Non-White	-0.261*** (0.0189)	-0.252*** (0.0182)
Percent Special Education	-0.721*** (0.0644)	-0.461*** (0.0619)
Shares Building with other School(s)	-3.632*** (0.888)	-3.584*** (0.773)
(2010 Dummy) * (Receiving Public Assistance)		-0.0767 (0.0535)
(2010 Dummy) * (Limited English Proficient)		0.106* (0.0605)
(2010 Dummy) * (Transitory)		-0.283*** (0.0965)
(2010 Dummy) * (Non-White)		-0.0160 (0.0474)
(2010 Dummy) * (Special Education)		-0.103 (0.178)
Constant	117.1*** (0.948)	117.9*** (0.909)
Observations	2,918	2,918
R-squared	0.401	0.518

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 11. Proficiency Rates: Fourth-Grade Math Test, 2006-2009 versus 2010, student-weighted.

Variable	(1) Basic Model	(2) Interacted Model
2010 Dummy (1 when year is 2010, 0 otherwise)		4.694**
		(2.114)
Percent whose Families Receive Public Assistance	-0.116***	-0.111***
	(0.0182)	(0.0162)
Percent Limited English Proficient	-0.0165	0.000714
	(0.0242)	(0.0204)
Percent Transitory	-0.0710***	-0.0956***
	(0.00643)	(0.00618)
Percent Non-White	-0.232***	-0.202***
	(0.0155)	(0.0133)
Percent Special Education	-0.596***	-0.273***
	(0.0607)	(0.0472)
Shares Building with other School(s)	-2.609***	-2.518***
	(0.903)	(0.698)
(2010 Dummy) * (Receiving Public Assistance)		-0.0958*
		(0.0500)
(2010 Dummy) * (Limited English Proficient)		0.0362
		(0.0609)
(2010 Dummy) * (Transitory)		-0.269***
		(0.103)
(2010 Dummy) * (Non-White)		-0.116***
		(0.0426)
(2010 Dummy) * (Special Education)		-0.260
		(0.187)
Constant	116.6***	115.3***
	(0.789)	(0.704)
Observations	2,918	2,918
R-squared	0.281	0.510

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 12. Proficiency Rates: Eighth-Grade English Language Arts Test, 2006-2009 versus 2010, student-weighted

Variable	(1) Basic Model	(2) Interacted Model
2010 Dummy (1 when year is 2010, 0 otherwise)		-2.575 (5.299)
Percent whose Families Receive Public Assistance	-0.364*** (0.0349)	-0.387*** (0.0380)
Percent Limited English Proficient	-0.391*** (0.0442)	-0.412*** (0.0514)
Percent Transitory	-0.144*** (0.0117)	-0.153*** (0.0119)
Percent Non-White	-0.172*** (0.0338)	-0.149*** (0.0379)
Percent Special Education	-1.243*** (0.107)	-1.072*** (0.123)
Shares Building with other School(s)	-3.847*** (0.890)	-3.779*** (0.881)
(2010 Dummy) * (Receiving Public Assistance)		0.0418 (0.0793)
(2010 Dummy) * (Limited English Proficient)		0.190** (0.0913)
(2010 Dummy) * (Transitory)		-0.295** (0.117)
(2010 Dummy) * (Non-White)		-0.0897 (0.0759)
(2010 Dummy) * (Special Education)		0.0913 (0.251)
Constant	116.1*** (2.223)	116.7*** (2.500)
Observations	1,661	1,661
R-squared	0.511	0.535

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 13. Proficiency Rates: Eighth-Grade Math Test, 2006-2009 versus 2010, student-weighted.

Variable	(1) Basic Model	(2) Interacted Model
2010 Dummy (1 when year is 2010, 0 otherwise)		1.773
		(5.272)
Percent whose Families Receive Public Assistance	-0.261***	-0.294***
	(0.0398)	(0.0426)
Percent Limited English Proficient	-0.0477	-0.0647
	(0.0519)	(0.0593)
Percent Transitory	-0.237***	-0.248***
	(0.0135)	(0.0138)
Percent Non-White	-0.270***	-0.236***
	(0.0360)	(0.0396)
Percent Special Education	-1.187***	-0.896***
	(0.118)	(0.134)
Shares Building with other School(s)	-4.491***	-4.372***
	(1.102)	(1.081)
(2010 Dummy) * (Receiving Public Assistance)		0.0671
		(0.0958)
(2010 Dummy) * (Limited English Proficient)		0.186
		(0.116)
(2010 Dummy) * (Transitory)		-0.201
		(0.131)
(2010 Dummy) * (Non-White)		-0.155*
		(0.0810)
(2010 Dummy) * (Special Education)		-0.379
		(0.289)
Constant	123.7***	123.6***
	(2.122)	(2.366)
Observations	1,666	1,666
R-squared	0.418	0.452

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Dispersion of Test Outcomes

The final test measured the distribution of standardized test performance across schools. Notably, I found evidence that test performance actually became more equal among students in the bottom half of the resource distribution. However, it does not appear that equality in the percentage proficient increased overall.

As seen in Figure 5 through Figure 8, the dispersion of test results appears to have followed similar patterns for each test group, with the Gini coefficient and coefficient of variation appearing to rise in 2010 and the constructed variable (*1* – (*McLoone index*)), which I used to reflect only schools in the bottom half of the resource distribution, appearing to fall. This would suggest that equality in percent proficient increased for schools in the bottom half of the resource distribution but fell overall.

Comparing trends in each variable before and during 2010, the changes apparent on the graph (a fall in the constructed McLoone value and a rise in the other two values) are statistically significant for the fourth-grade English Language Arts and math scores (most have $p<0.01$[44]). However, though the fourth-grade test scores for the bottom half of the resource distribution became more equal among elementary schools, the average proficiency rates were lower in 2010 than previously for both fourth-grade English Language Arts ($p<0.05$) and fourth-grade math ($p<0.01$). For the eighth-grade results, the only statistically significant trend was a rise in the coefficient of variation and the Gini coefficient for English Language Arts ($p<0.1$). Neither the mean test scores nor the distribution of scores for the bottom half of the resource distribution was statistically

[44] The one exception was the 95% confidence level for the McLoone value describing the distribution of fourth-grade English Language Arts results.

significantly different in 2010 versus previously, and no significant changes appeared in the eighth-grade math results.

These data suggest that there may have been some equalization in the proficiency rates of the schools with the lowest per-student resources with the implementation of FSF; however, they also suggest that those proficiency rates were lower in 2010 than previously. Unfortunately, it is very difficult to make substantial claims about trends based on so few data points. Nonetheless, they provide a snapshot to which future findings can be compared.

Figure 5. Dispersion of Fourth-Grade General Education English Language Arts Proficiency Rates Across Elementary Schools, 2006-2010.

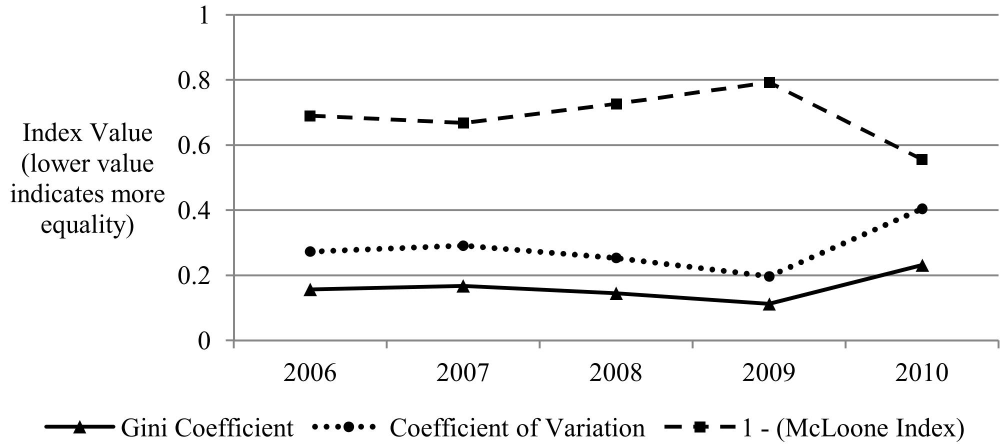


Figure 6. Dispersion of Fourth-Grade General Education Math Proficiency Rates Across Elementary Schools, 2006-2010.

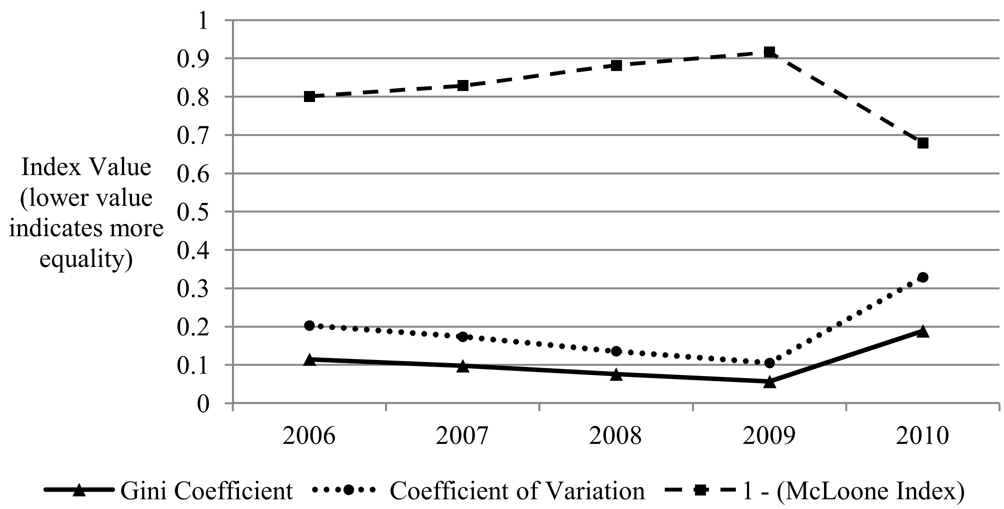


Figure 7. Dispersion of Eighth-Grade General Education English Language Arts Proficiency Rates Across Middle Schools, 2006-2010.

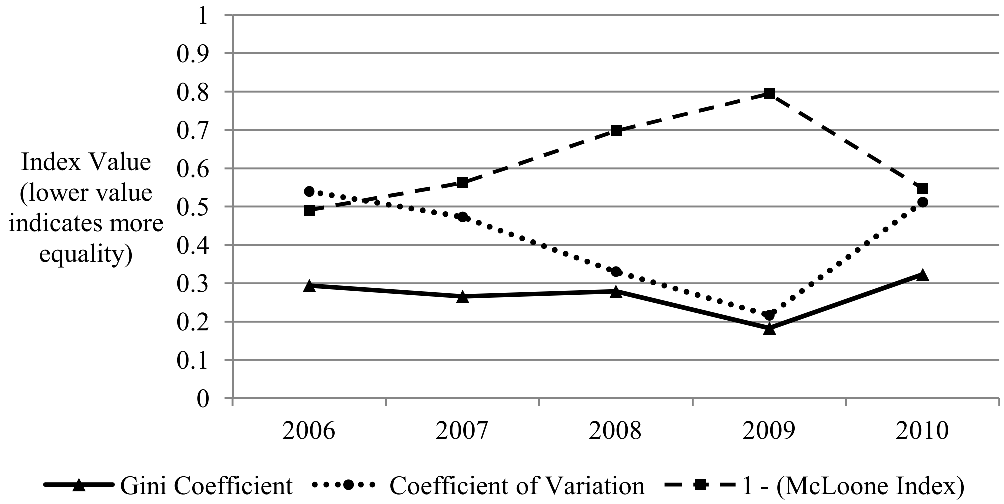
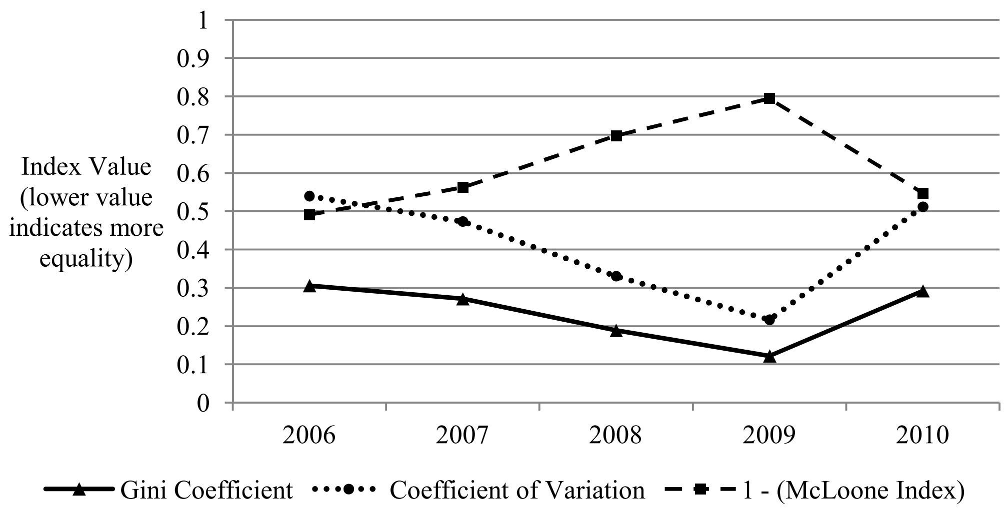


Figure 8. Dispersion of Eighth-Grade General Education Math Proficiency Rates Across Middle Schools, 2006-2010.



CHAPTER SIX: DISCUSSION AND CONCLUSION

Findings in Context

As described in Chapter Three, I was able to update and add to three major studies that addressed questions of equity in New York City's public schools. Iatarola and Stiefel (2003) examined inputs and outputs across elementary and middle schools in the 1998 fiscal year. Unsurprisingly, they found that student need characteristics are associated with lower scores, as I did. However, their estimations of the coefficients of variation describing the distribution of money in 1998 are generally higher than the ones that I estimated for the following decade; they also found that "baseline" (not special needs) funding was positively associated with a school's percentage of transitory students but negatively associated with its percentage of Limited English Proficient students, all else equal. While this is the opposite of the pattern that I observed across my later dataset, Rubenstein and colleagues (2007), examining the school district three years later, found patterns more similar to the ones I observe. Specifically, spending per student is positively associated with a school's percent of Limited English Proficient, special education, and poor students, all else equal. Finally, Stiefel and Schwartz (2011) analyzed fiscal years 2001 and 2008, finding positive associations between student need indicators and spending per student, especially in 2008. This is compatible with my findings that spending per student was overall positively associated with student need. Interestingly, the increase in the "need-spending" relationship that Stiefel and Schwartz observed taking place between 2001 and 2008 largely is not observed when comparing 2008-2010 with prior years.

Opportunities for Future Work

These results present two especially pressing opportunities for future work. The most obvious is the need to push the City to produce publicly available databases on school spending <u>and</u> student characteristics that are as complete and accessible as NYC DOE's database on test performance. A major limitation of this study is the inability to control for more student characteristics. This obscures the interpretation of the relationship between spending and variables like the building sharing variable. Easily accessible information about demographic information is needed (for example, <u>students'</u> neighborhood's property values and crime rates and average parent salary and educational attainment, at a neighborhood level[45]). Coupled with reliable information on each school's Title I status and its population of students eligible for free or reduced price lunch, much of the threat of omitted variables bias could be mitigated, leading to far more dependable estimates. Controlling for student need such that factors like race are less likely to be serving as proxies for student need would make it easier to measure horizontal equity – that is, the degree to which all students (regardless of non-need factors like race) are treated equally, controlling for need. Because it would allow the public to measure where their tax dollars are going and enable researchers to better explore the relationships between spending and outcomes, such transparency would be desirable, especially as a complement to the City's existing School Report Cards.

Another opportunity for future work – perhaps even more daunting – is the need to produce better estimates of the education production function. A major limitation of this study and its predecessors is that without a better understanding of what amount of

[45] Though it would not be provide very fine-grained pictures of students' backgrounds, it would be helpful even if schools were to provide the number of students living in various ZIP codes.

spending is required by or optimal for a given student need, it is impossible to make claims about whether a school district is providing funding adequate to allow its schools to educate their students. I am limited to making statements about the trends in the need-spending association over time, and it is difficult to interpret those changes if it is not known whether the original spending level is above or below that required by student need. That is, it is impossible to interpret an increase in the association between need and spending as a "good" or "more equitable" change if it is not known whether the initial association was above, below, or at the adequate level. Determining thresholds or at least ranges for "adequate" levels of spending for student need may be even more important than continuing simply to monitor the relationship between spending and student need.

The major contribution of this thesis is to provide a much-needed update on the patterns of spending distribution in New York City immediately before and after the introduction of Fair Student Funding. I found that while student need generally appears to be associated with spending in the City's public schools, it does not appear that that relationship generally increased with the implementation of Fair Student Funding. In addition, I found evidence that, as in 1998 (Iatarola and Stiefel (2003)), schools with more high-needs students still appear to perform worse than their peers on standardized tests. More research – both on how NYC DOE distributes funds and on how it should – would help the public ensure that NYC DOE provides a fair education to its students.

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HONOR PLEDGE

This paper represents my own work in accordance with University regulations.