SCHOOL VOUCHERS: SOURCE/AMOUNT OF FUNDS AND EFFECTS ON MATH/READING SCORES

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By

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The debate over the educational system in this country has mainly focused on the amount of money spent by the government. This thesis will examine whether the source of funding (partially private versus fully public) has an effect on the math and reading scores of the students in the system. School voucher programs have been a contentious idea ever since Milton Friedman proposed them to end the quasi-monopoly that public education had in this country in the 1950s. However, some policymakers have been ardently opposed to vouchers, defeating or limiting them as much as possible to ensure that public education remains the norm for the citizens of this country. Researchers have attempted to isolate the effects of vouchers on test scores, graduation rates, and dropout rates. Unfortunately, the small nature of the programs has not enabled analysts to determine if there is a generalizable and significant correlation between any of these variables.

Extensive analyses and comparisons with regards to the source and amount of money have not been performed concerning school voucher programs. The datasets
I acquired for this project come from Milwaukee, Wisconsin and Charlotte, North Carolina. Milwaukee funded their system much more generously while Charlotte provided a partial offset of private school tuition with participants supplementing the rest of the cost. My hypothesis is that privately-run, partially funded systems will perform better. The results do not prove this hypothesis and point to a slight decrease in test scores for those students participating in a private voucher system. However, the cost variable shows modest gains in math scores regardless of the source of the funds. While more money per voucher may be a wise policy choice, it will not routinely bear out higher test scores for these students. The gains are miniscule enough to question whether fully funding the cost of tuition at a private school is necessary. Regardless of these results, students who accepted and used the voucher had dramatic increases in both math and reading test scores. In short, vouchers have made a positive difference for students who utilized them, regardless of the source/amount of funding.
Acknowledgements

First and foremost, I want to thank my thesis adviser, Andrew Wise. His patience, sanity, and knowledge of STATA code have all combined to ensure that this project has been completed. Working with him over the past seven months has been tremendously helpful, and will forever have my gratitude. Mary Seiffe, my aunt, deserves hours of praise and thanks for keeping me on track for her repeated phone calls and words of encouragement. Bob and Mary Therese Wille, my parents, ensured that I was well-fed and clothed. Professor Patrick J. Wolf, head of the School Choice Demonstration Project at the University of Arkansas, was an informative resource to track down datasets. Professors Jay Greene and Joshua Cowen provided me with the evaluation of the Charlotte, North Carolina privately-funded school voucher program from 1999. Professor John Witte provided me with the evaluation of the Milwaukee, Wisconsin publicly-funded school voucher program from 1990-1995, the nation’s oldest school voucher program. Jessica Nysenbaum of the Mathematica Policy Research, Inc. and a former GPPI student attempted to facilitate datasets from her place of work and deserves recognition as well. In addition, Kerry Pace and Leslie Evertz of the Georgetown Public Policy Institute supplied valuable information and numerous checklists to complete.
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Chapter 1. Introduction

The debate over the educational system in the United States of America has focused a lot of attention on the amount of money spent by the government. Parties on one side of the debate, notably editorial boards, teachers’ unions, and liberal politicians, claim that more money is always a necessary component to repair our failing schools. Others claim that the public school system in this country has utterly failed and should be completely privatized. This discussion should not trend toward whether we need to appropriate more funding for our classrooms but rather whether the money currently designated is being used efficiently and effectively. Central to this dialogue is the idea of giving parents and children vouchers to use on a school of their choice. This thesis will examine whether the source of funding (partially private versus fully public) has an effect on the math and reading scores of the students participating in the system.

The District of Columbia Public Schools system has one of the highest spending-per-pupil rates in the country and at the same time one of the lowest average scores on standardized reading and math tests. In 2003, Congress passed the DC Opportunity Scholarship Program providing 1,900 low-income students via lottery a publicly-financed voucher of $7,500 to spend on tuition at a private or charter school of their choice within the city. The response was overwhelming as over 9,000 students
applied to become one of the few to be awarded a voucher. Over the last 5 years, numerous data analyses have been performed on the program’s effects concerning the math and reading scores of the participants. In addition to the Department of Education’s own study of the program, numerous think tanks and educational institutions, including the Georgetown Public Policy Institute, have performed research as well. The conclusion among each of these studies has been that the participants in the voucher program have improved their reading scores while making slight, insignificant gains in their math scores. On top of that, the program spends less per student than public schools, so you get better results for less money, a result that is found across other voucher programs. In short, the policy has worked.

In addition to the District of Columbia program, numerous other school voucher programs have been enacted in cities and states across the country. Charlotte, North Carolina, Milwaukee, Wisconsin, and New York City, New York used vouchers systems in the 1990s. Since the Supreme Court’s 2002 decision finding that school voucher programs did not violate the establishment clause of the First Amendment (i.e., providing vouchers that might be used in religious schools did not go against the separation of church and state), many more cities and states have been experimenting with vouchers. Utah voters recently almost passed a universal voucher program but were defeated at the polls. When looking at the different school voucher systems set
up across the country, one must consider a number of factors: how the vouchers are awarded and funded (via lottery, partially funded, and the source of funds: private or public), who gets selected to participate (low income students, only public school students, special needs children), and what the studies are actually measuring (the change in reading and math scores, the alleviation of poverty among participants, the change in graduation rates among other measures). For the model I estimate, I will look at the change in reading and math scores among participants in both privately and publicly funded voucher systems in two cities. However, I enhance the model by creating independent variables that examine the different ways each program is funded and whether that has an effect on the reading and math scores for the participants. Some caution is required here as selection bias and endogeneity will be two big concerns. However, I am collecting data from numerous sources and have created a dataset that will adjust for at least some of these concerns. This was done by collecting data from two different cities that used lotteries to select low-income students for vouchers and comparing programs that had privately financed systems through donations versus publicly financed voucher systems. I also adjust for demographic factors. Charlotte, North Carolina and Milwaukee, Wisconsin both enacted vouchers systems that have a number of these characteristics. And fortunately, both systems were designed specifically for each city and funded in different ways. This fact will be
beneficial when it comes to the final analysis of the question this thesis hopes to answer: Does the source of funding as well as the amount for school voucher programs have a statistically significant effect on the math and reading scores of those students who participate?

When it comes to improving children’s education in the United States, we should reexamine the same old tired and usual ideas, or perhaps we should throw them out altogether. Education has traditionally remained a state and local issue as per the 9th and 10th amendments of the Constitution. However, over the past 45 years, the federal government has massively expanded its role in the country’s education system with little to show in terms of results. In his Inaugural Address, President Obama said he would not look at whether a program is a liberal idea or a conservative idea but whether it works. I am conducting this study to see whether school vouchers work, and if so, what makes them work. To the best of my knowledge, such a study comparing the merits of different voucher systems has never been performed.

This paper proceeds as follows: Chapter 2 provides a background of education policy since the late 1700s and a Literature Review of scholarly work concerning school voucher programs. It is also identifies the relevant contribution of this study. Chapter 3 provides a theoretical framework which lays out the method of estimating a theoretical model involving school voucher programs and test scores. Chapter 4
provides a description of both datasets collected and multiple tables describing the variables from each program. Chapter 5 lists the empirical model used in this study and a comprehensive catalog of all the variables and their explanations. Chapter 6 is the results section for both models estimated in this study. The estimated coefficients, and their statistical significance, t-scores, and other measures are found here. Chapter 7 is the policy recommendations and conclusion section which gives advice to both data collectors and policymakers regarding school voucher programs. Chapter 8 is the bibliography and citations section.
Chapter 2. Background and Literature Review

Background

Americans consistently rank education near the top of policy issues most important to them. Year after year, politicians and policymakers promise progress and improvement in the nation’s schools with little to show for it. Let’s first take a brief look at the development of education and policy in the United States since the country’s founding. Following the American Revolution, state leaders came together to establish the Land Ordinance of 1785, setting aside 640-acre plots of land “for the maintenance of public schools.”¹ In addition, the Confederation Congress produced the Northwest Ordinance of 1787 containing the following line: “Religion, morality, and knowledge… are necessary to good government and the happiness of mankind, schools and the means of education shall forever be encouraged.”² Access to universal and free education for all citizens was thus an ideal of the nation’s founders. Throughout the 1800s, public schools sprung up throughout the country. Regulation, instruction, and funding remained a state and local concern as per the 10th amendment to the Constitution.³ Land grant universities and normal teaching schools came about

¹ http://west.stanford.edu/cgi-bin/pager.php?id=49
² http://www.earlyamerica.com/earlyamerica/milestones/ordinance/
³ “The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.” Simply put, those powers not specifically listed in the Constitution for the national government revert back to the state and local governments, including control of education.
with the Morrill Act of 1862. The federal government remained solely in the funding and property related aspects of education for the majority of nation’s history.

Following World War II, the introduction of the G.I. Bill and the beginning of the Civil Rights Movement led to amplified national involvement. The Elementary and Secondary Education Act of 1965 heavily invested federal funds in public schools across the nation, more commonly known today as the No Child Left Behind Act (which is currently up for reauthorization). Unfortunately, the increased federal presence has not had a significant effect on student outcomes.

Different solutions have been proffered by various interest groups. These proposals have included smaller class size, paying teachers better, increasing the amount of public money invested, mandating specific requirements of teachers, and augmenting after-school programs. Besides these, school vouchers have been one of the innovations put forward by researchers. The origins of these programs go back to the 19th century. “America’s first school voucher program was established in Vermont in 1869. The Vermont ‘town tuitioning’ program provides vouchers for students in rural areas without public junior high or high schools.” School vouchers are programs

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4 This act set aside land for institutions of higher education funded by the federal government.
5 An Act of Congress, passed in 1965, to ensure equal access to education for all children and to press states to push for higher standards. No Child Left Behind, passed in 2001, conditions aid-to-states on setting standards for basic skills tests in math and reading with the ultimate goal of 100% proficiency in these subjects by 2014. Students who were not proficient and remained in a school that did not improve for 2 years had the option of switching schools or obtaining a tutor.
that allow students in public schools to use taxpayer or private foundation dollars to choose a private school. “Of the nearly 60 million school-aged children in the U.S.: 87% attend a public school, 11% attend a private school, and approximately 2% are home-schooled. Fewer than 60,000 currently participate in a publicly-funded school voucher program.”  

Policymakers don’t pretend to believe vouchers are the silver bullet to the problems facing this country, but supporters have put forward strong arguments for their expansion and funding to make significant improvements. They arose out of a reaction to increased governmental spending on public schools, particularly in poor and urban areas, for decades with meager results concerning test scores and graduation rates. While different forms of public funding have gone towards private schools in the past, the modern voucher concept has only been around in practice for the last twenty years. Appropriating funds for a limited, randomly-selected number of students to choose a private school began with the Milwaukee Parental Choice Program in 1990 and is still in place today. Other voucher programs have sprouted up in cities across the country. Researchers have been studying their effects for the past two decades as well. The following list compiles the majority of that research as well as my contribution to it.

Literature Review

Research on vouchers is divided into four general categories. First, overviews of other research survey other studies and come to general conclusions. Second, one set of studies find modest gains, although these studies are sometimes criticized as “advocacy research” promoting school vouchers. A third group of studies finds that the benefits of vouchers have been overstated. Finally, another set of studies examines the effect of voucher programs on the performance of public school students.

The most general look at vouchers is Rouse, et. al. (2008). Professor Rouse and others provide an in-depth analysis of school voucher experiments and future policy implications of the results found. - Wolf (2008) demonstrates that publicly-funded school voucher programs do succeed in targeting and enrolling the disadvantaged groups of society including poor children, the disabled, and foster children. He cites examples from Milwaukee to Washington, D.C. to Utah to Arizona as evidence that vouchers are not attempts to provide wealthier, advantaged public school children the opportunity to attend private school. He goes on to not the difficulty in determining a direct correlation between vouchers and student achievement: “The parent motivation associated with private school enrollment – with or without a government-financed voucher – could plausibly influence student achievement in the long run independent of the effects of the private school.” He also
notes the best methods to analyze school vouchers is using randomized field trials instead of longitudinal studies and responds to critics of vouchers when it comes to bias: “If voucher students learn more because they are surrounded by more advantaged peers in their new schools, then that is an explanation for why vouchers work, not something that should be subtracted out from any calculation of whether or not vouchers work.”

The next set of studies finds at least modest improvements in test results from voucher programs. The most consistent outcome is increased parental satisfaction on the part of parents looking to enroll their students in a private school through these programs. In addition, researchers including Rouse (1998), Metcalf (1999), and Wolf (2001) have all noted vouchers spurring more parental involvement with regards to children’s extracurricular activities, homework, and tutoring. In addition, these researchers have found slight gains in different test scores of voucher recipients. Rouse (1998) showed that “students in the Milwaukee Parental Choice Program had faster math score gains than, but similar reading score gains to, the comparison groups.” Metcalf (1999) showed that there appeared to be positive limited, achievement at the end of the two years of the program.

Wolf (2001) found gains among different subgroups within the voucher program. African-Americans who accepted a scholarship had a combined composite
math and reading score of nearly 9.2 points higher after three years in the program versus those African-Americans not accepting or being declined vouchers. Latinos saw no increased gains on either math or reading composite scores throughout any year of the program. At the same time, Lubienski - et. al. (2008) has noted that voucher research may be distorted by those who are advocating for an expansion of the programs: “Researchers supported by voucher advocacy organizations typically use flawed methodology in their attempts to find a positive academic impact for vouchers, misrepresent the findings of other research studies, and selectively ignore studies that contradict their claims.” The majority of research has been performed by independent analysts who are committed to looking dispassionately at the data and letting it speak for itself. Greene (2001) found statistically significant gains for those students accepting vouchers with math scores increased by 5.9 percentile points higher on math scores and 6.5 percentile points higher on reading scores compared to public school counterparts. Parental satisfaction and involvement also increased here as well. Witte (et. al. 2008) has studied the Milwaukee Parental Choice Program ever since its inception in 1990 and has found increases in both math and reading scores once he is able to study children who remain in the program beyond three years. The effects of the voucher take some time but do eventually work.
A third group of studies finds that the benefits of vouchers have been overstated. Ladd (2002) uses both national and international evidence to demonstrate why achievement gains are completely exaggerated and would not benefit students on a universal scale. Carnoy (2001) looked at a number of school voucher studies and found implantation problems as well as claims that improvements occurred when they did not. He states the following: “Moreover, the results are marked by broad inconsistencies across grades, academic subjects, and racial groups.” Once again, Lubienski -et. al. (2008) noted that “while improved student achievement remains the most prominent argument in favor of voucher programs, this claim is not supported by the weight of the best available evidence.”

Lastly, researches have studied voucher programs and their effects on public schools. Greene, -et. al. (2001 & 2003) look at the Florida A+ Program to compare the changes public schools made as a result of competition from vouchers. Both public schools facing competition as well as public schools faced with the threat of vouchers saw statistically significant gains in math and reading test scores of their students. Schools that had been threatened with vouchers performed even worse once the threat was removed. This fact demonstrates that competition to the quasi-monopoly of public school education can spur important changes in achievement. Rouse (2007) looked at data over five years and concluded similarly. Figlio (et. al. 2004) discovered a
comparable result but believed that it may have been due to other factors besides school vouchers including better teacher performance in the public schools as well as increased parental involvement. West (2005) found significant effects for African-American students who remained in the public schools but not for white and Hispanic students. Outside of Florida, a large-scale analysis of the threat of competition has not actually been studied.

The finding of a competitive effect from vouchers is a potential answer to studies that find no gain among students receiving vouchers. If vouchers inspire better performance at public schools, their implementation might improve results for all children, both those receiving them and those remaining public schools. Such a result could create the appearance that vouchers were having no effect when in fact they were improving results for everyone.

My contribution to this research focuses on both the source and cost of the voucher accepted and used by student participants. Controlling for demographic variables, the model I estimate looks at whether the amount of the voucher (covering the entire cost versus partial cost of private school) and the source of the voucher (from taxpayer dollars versus private funds) has a specific and direct effect on the math or reading scores of the students in the program. While many analyses have looked at a number of factors across school choice programs, no researcher has compared private
and public systems focusing on the cost of the voucher used by the students. Given the controversy in the literature described above, I believe such a sophisticated analysis of voucher programs and their characteristics is critical in guiding policy. I now turn to the theoretical framework that guided my empirical examination.
Chapter 3. Theoretical Framework

I employ the following theoretical framework:

\[
\text{Test Score} = \alpha \text{ choice} + \beta \text{ demographics} + \gamma \text{ source} + \delta \text{ cost} + \text{error term (1)}
\]

where choice is whether a student participates in a voucher program, demographics adjust for the characteristics of the student, source represents whether funds for the program come from private or public sources, cost is the amount of the voucher, and the error term is the stochastic error.

The fundamental rationale behind the model I estimate is an examination of the source and amount of funding for the voucher program and whether these have a specific, direct, and significant effect on the math/reading scores of those who participate in the voucher system. My hypotheses are that privately-run school voucher programs with less funding per voucher compared to publicly-run school voucher programs with more funding per voucher will increase the math and reading scores of student participants. In short, students in privately-funded, partial tuition systems should outperform those in publicly-funded, full tuition systems. I have collected two datasets with variables that will allow me to test these hypotheses.

The models will contain a number of variables including math/reading scores, the source of funding for vouchers, the amount of funding, and a number of
demographic variables that may have a direct effect on the dependent variable of math/reading scores.

The best method to study the true effect of voucher source/amount of funding on math/reading scores would be to set up a voucher system in one city where half the funding comes directly from private donations and goes to a specific number of students. And then the other half of the funding comes directly from public education funds and goes to a specific number of students. Then, they would all be analyzed on the same exact test in order to compare results. Since this theoretical method is only theoretical, we will have to make do with the systems that have been set up. I therefore now turn to the data and methods I employed to examine existing voucher systems.
Chapter 4. Variables of Analysis

Data Descriptive Statistics

Sources and Limitations of Data

My data come from two school voucher programs, The Milwaukee Parental Choice Program and the Charlotte Children’s Scholarship Fund. The Milwaukee Parental Choice Program (MPCP) began in the 1990-1991 school year as an opportunity for public school children and their parents to enroll in a lottery and to choose to attend a private, non-religious school. The data for Milwaukee were provided to me by John Witte, the principal collector and analyst of the program, via the Data and Information Services Center (DISC) of the University of Wisconsin. According to the DISC website, “The Milwaukee Parental Choice Program dataset was collected as part of annual evaluations of the Milwaukee Parental Choice [pilot] Program. The research program began in the fall of 1990 and continued to 1995. The program was designed to provide opportunities for poor students in Milwaukee Public Schools. In lieu of tuition, the State of Wisconsin paid the private schools what the Milwaukee Public Schools would have received in state aid for each student. The program is the first in the United States to provide major subsidies to private schools as part of a general voucher program.”

The private Children’s Scholarship Fund began in Charlotte, North Carolina
during the 1999-2000 school year. The data for Charlotte were provided to me by Jay Greene of the University of Arkansas and Joshua Cowen of the University of Kentucky, two leading experts in educational reform and school voucher programs. The main limitations to the Charlotte dataset are few but important. The dataset only measures one school year of students participating in the program. A dataset including up to 5 school years (as Milwaukee’s does) would have been much more fruitful and helpful to this thesis or any examination of the effectiveness of the program. In addition, no information was collected on the fathers of these students, only the mothers. Many of the variables did not contain explanations behind their measurements. Contact with the researchers did result in explanation of certain variables.

There are severe limitations to both datasets. The Milwaukee dataset is made up of 45 separate STATA files making it extremely difficult to analyze. Thirty nine separate merges were performed to create one large, separate file containing all 5 school years of the MPCP. Certain files include a number of demographic variables with empty observations. This fact forced me to drop a number of important and vital demographic variables; including the race and gender of the children in both the choice and control groups. I intended to include more variables in my model to explain the
variation in test scores but was not able to do so as a result. Omitted variable bias is a strong concern in my model but is unavoidable given the state of the data.

In addition to these two datasets, attempts were made to collect data from two other school voucher programs. The inspiration for this thesis came from the only federally funded school choice program in the country: The Washington, D.C. Opportunity Scholarship Program which provides students a voucher of $7,500 to choose a private school. Unfortunately, the dataset, collected by the Department of Education, is currently under restricted use and limited to approved, licensed researchers. The dataset would not be released without extensive, bureaucratic requirements which the Georgetown Public Policy Institute was not able to accommodate.

I also attempted to collect data from a privately-funded, partial tuition scholarship program from the New York City school choice program during the years 1997 to 2001. The original researcher and analyst, Paul Peterson, directed me to Mathematica Policy Research, Inc. to obtain the set. Unfortunately, problems similar to those encountered with the Washington, D.C. data occurred. Severe restrictions were to be placed on the user of the set including a computer without access to the Internet as well as password-protecting all files. Ultimately, it was impossible to
accommodate the restrictions placed on the use of the data. Future concerns about data collection will be addressed in the Policy Results and Recommendations section.

Once merged together into a panel dataset, only 1,115 observations remained. Unfortunately, there were hundreds of students from the Milwaukee dataset that had to be dropped as a result of partially answered survey questions. Table of descriptive statistics follows.

Table 1: Charlotte Descriptive Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Obs.</th>
<th>Mean/Count</th>
<th>Standard Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
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</table>

*Dummy variable, for these variables, the Mean/Count shows the number of observations equal to 1.
Table 2: Milwaukee Descriptive Statistics

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<th>Variable</th>
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*Dummy variable, for these variables, the Mean/Count shows the number of observations equal to 1.
Table 3: Descriptive Statistics, Combined Datasets

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<th>Obs.</th>
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<th>Std. Dev.</th>
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<td>2.451725</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Language*</td>
<td>1083</td>
<td>1057</td>
<td>0.1531427</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Momrace*</td>
<td>1115</td>
<td>85</td>
<td>0.2654899</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cost</td>
<td>1074</td>
<td>3,989.451</td>
<td>1,895.456</td>
<td>1700</td>
<td>7500</td>
</tr>
<tr>
<td>Charlotte1*</td>
<td>1115</td>
<td>205</td>
<td>0.3875409</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

*Dummy variable, for these variables, the Mean/Count shows the number of observations equal to 1.

A full description of the variables can be found in the next chapter. There, I discuss my specific empirical methods.
Chapter 5. Empirical Model

Math Test Score = \( \beta_0 + \beta_1 \text{Choice} + \beta_2 \text{momeduc} + \beta_3 \text{momrace} + \beta_4 \text{income} + \beta_5 \text{language} + \beta_6 \text{married} + \beta_7 \text{Charlotte} + \beta_8 \text{cost} + \text{error term (} \mu_1 \text{)} \) (2)

Reading Test Score = \( \beta_0 + \beta_1 \text{Choice} + \beta_2 \text{momeduc} + \beta_3 \text{momrace} + \beta_4 \text{income} + \beta_5 \text{language} + \beta_6 \text{married} + \beta_7 \text{Charlotte} + \beta_8 \text{cost} + \text{error term (} \mu_2 \text{)} \) (3)

I estimate these equations using ordinary least squares.

The Math dependent variable is a measure of the student’s performance on the Iowa Test of Basic Skills, ranging from 0 to 99.

The Read dependent variable is a measure of the student’s performance on the Iowa Test of Basic Skills, ranging from 0 to 99.

The Choice variable is a dummy variable that is equal to 1 when a student has accepted or been selected via lottery to receive a voucher. It is a part of the model to explain the difference between students who participated in the program and those who did not. Any student measured with a 1 accepted the voucher and chose to participate.

The momeduc variable is an ordinal variable that increases from 1 to 7 based on the mother’s level of education. A 1 is equal to completion of eighth grade. A 2 is equal to completion of some high school. A 3 is equal to completion of a GED or high school equivalency program. A 4 is equal to completion of high school. A 5 is equal to completion of some college. A 6 is equal to completion of college. A 7 is equal to
completion of a post-graduate degree. It is a part of the model to explain how a mother’s level of education affects the performance of her child on math and reading tests.

The *momrace* variable is a dummy variable that is equal to 1 if the mother of the student is white and 0 if the mother of the student is another race. This variable is included in the model to discover whether or not the achievement gap is prevalent even within school voucher programs. There has been a disparity in test scores between white students on the one hand and African-American and Hispanic students on the other over the past 40 years. (See: http://www.edweek.org/rc/issues/achievement-gap/)

The *income* variable is an ordinal variable that increases from 1 to 10 based on the income level of the student’s parents.

A 1 is equal to an income level between $0 and $2,999.
A 2 is equal to an income level between $3,000 and $4,999.
A 3 is equal to an income level between $5,000 and $7,499.
A 4 is equal to an income level between $7,500 and $9,999.
A 5 is equal to an income level between $10,000 and $14,999.
A 6 is equal to an income level between $15,000 and $19,999.
A 7 is equal to an income level between $20,000 and $24,999.
An 8 is equal to an income level between $25,000 and $29,999.
A 9 is equal to an income level between $30,000 and $39,999.
A 10 is equal to an income level greater than or equal to $40,000.
This variable is included in the model to determine whether an increase in a family’s income will result in better test scores for students and to adjust generally for socioeconomic factors.

**Language** is a dummy variable which is equal to 1 if the student speaks English and 0 if the student speaks another language first. Students who speak English as a first language usually perform better on standardized tests. This variable looks at whether that result is true within voucher programs as well.

**Married** is a dummy variable which is equal to 1 if the student lives in a household with married parents and 0 if the student lives in a household without married parents (includes divorced, widowed, single, and parents living together not married). Historically, two-parent married households have produced children who perform higher on math and reading scores. This variable is included to determine whether that holds true.

**Charlotte** is a dummy variable which is equal to 1 if the student participated in the privately funded Charlotte school voucher program and is equal to 0 if the student participated in the publicly funded Milwaukee Parental Choice Program. The variable is central to the model I am running. It is there to determine whether or not privately
funded and run voucher programs perform better than publicly funded and run voucher programs.

Cost is a variable that measures the maximum amount of money a student participating in the voucher program may receive. It is based on the Year the student participated as well as whether or not the child was admitted to the program.

If the Year is 1990, the amount of the voucher is equal to $2,446.
If the Year is 1991, the amount of the voucher is equal to $2,700.
If the Year is 1992, the amount of the voucher is equal to $2,900.
If the Year is 1993, the amount of the voucher is equal to $3,050.
If the Year is 1994, the amount of the voucher is equal to $3,209.
If the Year is 1999, the amount of the voucher is equal to $1,700. (Data for students in Charlotte were only available for this year).

If the Year is 1990 and the student did not accept the voucher, the public school spending-per-pupil amount is $6,100.
If the Year is 1991 and the student did not accept the voucher, the public school spending-per-pupil amount is $6,400.
If the Year is 1992 and the student did not accept the voucher, the public school spending-per-pupil amount is $6,700.
If the Year is 1993 and the student did not accept the voucher, the public school spending-per-pupil amount is $7,200.

If the Year is 1994 and the student did not accept the voucher, the public school spending-per-pupil amount is $7,500.

If the Year is 1999 and the student did not accept the voucher, the public school spending-per-pupil amount is $5,500.

The **error term** includes all the omitted variables not included in the model that might have an effect on the math and reading scores of participants, and any stochastic variation not captured in the model.

I now turn to a discussion of the results from this model.
Chapter 6. Results

Below, I first discuss the estimation results from Equation (2), which examines reading test scores, and then I turned to the results from Equation (3), which examines math test scores.

Table 4: READING Test Scores as Dependent Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-Stat</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice</td>
<td>13.38653**</td>
<td>2.33</td>
<td>0.020</td>
</tr>
<tr>
<td>Momeduc</td>
<td>1.552637***</td>
<td>2.57</td>
<td>0.010</td>
</tr>
<tr>
<td>Momrace</td>
<td>10.68221***</td>
<td>3.78</td>
<td>0.000</td>
</tr>
<tr>
<td>Language</td>
<td>-15.67709***</td>
<td>-3.47</td>
<td>0.001</td>
</tr>
<tr>
<td>Income</td>
<td>0.5916264</td>
<td>1.49</td>
<td>0.136</td>
</tr>
<tr>
<td>Charlotte</td>
<td>-4.470291*</td>
<td>-1.65</td>
<td>0.099</td>
</tr>
<tr>
<td>Married</td>
<td>8.828437***</td>
<td>5.03</td>
<td>0.000</td>
</tr>
<tr>
<td>Cost</td>
<td>0.0015368</td>
<td>0.93</td>
<td>0.354</td>
</tr>
<tr>
<td>Constant</td>
<td>27.00282**</td>
<td>2.22</td>
<td>0.027</td>
</tr>
<tr>
<td>F-Stat</td>
<td>11.98***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R Squared</td>
<td>0.0936</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-Square</td>
<td>0.0858</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Obs.</td>
<td>937</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statistical Significance Level  *90%  **95%  ***99%
The **Choice** variable is statistically significant at the 95% confidence level. This result is consistent with the hypothesis that students who take the voucher or are selected randomly for the voucher do better on reading scores. Ceteris parabus, the vouchers increase a score on the Iowa Basic Skills reading test by 13.38653 points.

**Momeduc** is statistically significant at the 99% confidence level. This result is consistent with the idea that the more education a student’s mother has, the better the student will perform in school. Ceteris parabias, for every increase in mother’s education from one ordinal level to the next, a student who has accepted the school voucher will increase his/her reading test score by 1.552637 points.

**Momrace** is statistically significant at the 99% confidence level. This result is consistent with the idea that there is an achievement gap between white students and African-American or Hispanic students. Ceteris parabias, a student with a white mother will receive a reading test score 10.68221 percentage points higher than his/her African-American or Hispanic counterparts.

**Language** is statistically significant at the 99% confidence level. Ceteris parabias, students for whom English is a first language decrease their test scores by 15.67709 points. This result is not consistent with the idea that students who speak English as their first language will perform better on reading tests. An outlier problem

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8 See: http://www.edweek.org/rc/issues/achievement-gap/
exists here as only 14 students in a sample of 980 did not have English as their first language. Looking at the individual results for these students does display a tendency to do better than their peers. However, it is highly unlikely that this effect extends to the general population and probably is due to selection bias.

**Figure 1: Language and Reading Test Scores**

Income is not statistically significant. The coefficient on the variable is positive though, and it is near significant as the p-value is 0.136. This result is consistent with the idea that more income and wealth will result in higher test scores.
Ceteris paribus, an increase from one income level to the next will result in a 0.5916264 point increase on reading test scores.

**Charlotte** is statistically significant at the 90% level. The coefficient on the variable is negative though. This result is **NOT** consistent with my hypothesis that privately funded school vouchers will result in higher test scores for participants.

Ceteris paribus, a student who participated in the Charlotte school voucher program will result in a decrease of 4.470291 points on reading test scores. Of course, other differences, such as the method of student selection, but also unobserved differences, between Charlotte and Milwaukee account for some of this difference, but the result does not argue in favor of a privately-run system. One must take caution here to read too much into this result as data for the Charlotte program were only available for one school year.

**Married** is statistically significant at the 99% confidence level. This result is consistent with the idea and numerous studies that children living in homes with married parents perform better on standardized reading tests. The average student that has married parents scores 8.828437 points higher on reading test scores.

**Cost** is not statistically significant. The coefficient on the variable is positive though. This result is consistent with my hypothesis that paying more money with a voucher will not necessarily result in better test scores: the regression shows no
statistically significant relationship between spending more money on vouchers and higher reading scores.

The **R-Squared** measure is 0.0936 which is rather low even for panel data but may be partly explained by the likelihood of omitted variables.

The **F-Stat** is 11.98, which means that the model as a whole is statistically significant at the 99% confidence level.

The **number of observations** is only 937. This could be much larger if demographic variables had been better collected. As a result, a large number of students had to be dropped from the model. Given the complicated nature of the STATA files, the precise amount is difficult to determine, but it is in the hundreds.
Table 5: MATH Test Scores as Dependent Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-Stat</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choice</td>
<td>34.93608***</td>
<td>5.51</td>
<td>0.000</td>
</tr>
<tr>
<td>Momeduc</td>
<td>1.146009*</td>
<td>1.80</td>
<td>0.072</td>
</tr>
<tr>
<td>Momrace</td>
<td>13.3211***</td>
<td>4.56</td>
<td>0.000</td>
</tr>
<tr>
<td>Language</td>
<td>-27.28518***</td>
<td>-5.64</td>
<td>0.000</td>
</tr>
<tr>
<td>Income</td>
<td>1.092904**</td>
<td>2.56</td>
<td>0.011</td>
</tr>
<tr>
<td>Charlotte</td>
<td>-9.874234***</td>
<td>-3.44</td>
<td>0.001</td>
</tr>
<tr>
<td>Married</td>
<td>5.547376***</td>
<td>2.94</td>
<td>0.003</td>
</tr>
<tr>
<td>Cost</td>
<td>0.0056893***</td>
<td>3.10</td>
<td>0.002</td>
</tr>
<tr>
<td>Constant</td>
<td>-8.520935</td>
<td>0.64</td>
<td>0.524</td>
</tr>
<tr>
<td>F-Stat</td>
<td>18.67***</td>
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<td></td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.1464</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R-Square</td>
<td>0.1385</td>
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<td></td>
</tr>
<tr>
<td>Number of Obs.</td>
<td>880</td>
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</tbody>
</table>

Statistical Significance Level *90% **95% ***99%

The **Choice** variable is statistically significant at the 99% confidence level. This result is consistent with my hypothesis that students who accept the voucher or are randomly assigned via lottery will do better on math test scores. Ceteris parabis,
for every student who accepts the voucher, an increase of 34.93608 points will result on math test scores.

The **Momeduc** variable is statistically significant at the 90% confidence level. This result is consistent with the idea that mothers with more education will have children who perform better on math tests. Ceteris parabís, for every increase in education level of a student’s mother, the child will increase his/her math test scores by 1.146009 points.

**Momrace** variable is statistically significant at the 99% confidence level. This result is consistent with the idea that there is an achievement gap between white students and African-American or Hispanic students. Ceteris parabís, a student who has a white mother will see an increase of 13.3211 points on math test scores.

**Language** variable is statistically significant at the 99% confidence level. Ceteris parabís, students for whom English is a first language decrease their math test scores by 27.28518 points. This result is not consistent with the idea that students who speak English as their first language will perform better on reading tests. An outlier problem exists here as only 14 students in a sample of 980 did not have English as their first language. Looking at the individual results for these students does display a tendency to do better than their peers. However, it is highly unlikely that this extends to the general population and probably is due to selection bias.

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Income is statistically significant at the 95% confidence level. This result is consistent with the idea that more income and wealth will result in higher test scores. Ceteris paribus, an increase from one income level to the next will result in a 1.092904 point increase on math test scores.

Charlotte is statistically significant at the 99% confidence level. Ceteris paribus, a student who participated in the Charlotte school voucher program will result
in a decrease of 9.874234 points on reading test scores. This result is *NOT* consistent with my hypothesis that privately funded school vouchers will result in higher test scores for participants. Other factors are accounted for by this variable as well and caution must again be taken as only one year of data was available for the Charlotte program.

**Married** is statistically significant at the 99% confidence level. This result is consistent with the idea and numerous studies that children living in homes with married parents perform better on standardized math tests. The average student that has married parents scores 5.547376 points higher on reading test scores.

**Cost** is statistically significant at the 99% confidence level. Ceteris paribus, for every student who received a higher voucher amount from year to year, an increase of 0.0056893 points resulted on math test scores. This result is *NOT* consistent with my hypothesis that paying more money with a voucher will not necessarily result in better test scores. However, the value of adding an additional dollar to a voucher program will only result in an additional \(\frac{5}{1000}\)th of a point on math test scores. This magnitude is quite low. Fully covering the cost of a voucher may relieve some parents who worry about supplementing educational costs with their own money, but at the same time, forcing parents to bear some of the costs may get them more involved in their children’s lives and want to pick the best school.
The **R-Squared** measure is 0.1464 which is rather low for panel data but may be partly explained by the likelihood of omitted variables.

The **F-Stat** is 18.67, which means that the model as a whole is statistically significant at the 99% confidence level.

The **number of observations** is only 880. This could be much larger if the demographic variables had been better collected. A number of students had to be dropped as a result. Given the complicated nature of the STATA files, the precise amount is difficult to determine but it is in the hundreds.

### Hypothesis and Results

The hypothesis I have tested throughout this paper is that privately-run school voucher programs with less funding per voucher would increase the math and reading test scores of student participants relative to publicly-run school voucher programs with more funding per voucher. The results of my model have partially disproved this hypothesis. The privately-run Charlotte actually resulted in lower math test scores compared to the scores of Milwaukee students (the coefficients here were statistically significant). For reading scores, the results were also lower and statistically significant, although only at the 90% level. The cost variable produced higher math test scores overall. An increase in the amount of the voucher will result in a slight gain on
the math score for the student participants. When reading test scores were measured, the result was positive but statistically insignificant. Unfortunately, omitted variable bias may have notably influenced the results. While the voucher amounts do come from cities with comparable cost-of-living figures, the Charlotte data is from 1999 and not adjusted for inflation. Also, the voucher variables measure are the maximum a student may receive and not the actual amount given to schools participating in the system. These amounts varied per student and were based on a formula determined by the Milwaukee Public Schools. The students participating in the voucher system chose the private school to attend but did not actually see the amount of money covering that cost. In Charlotte, the students received up to $1,700 directly and also had to supplement the additional cost of the private school as well. The design of the system more than likely had an effect on the resulting school choices and test scores of participating students. In the future, better data acquisition and a reduction in omitted variable bias will greatly benefit school voucher programs and research. This is further discussed in the following, concluding chapter.
Chapter 7. Policy Recommendations and Conclusion

First and foremost, numerous attempts were made to collect datasets on school vouchers, from both privately-funded and publicly-funded systems. Unfortunately, most of the data are currently defined as “restricted use” which means that they are not available to the public including graduate students without an extensive, bureaucratic procedure. For example, the federally-funded Washington, DC Opportunity Scholarship Program dataset is currently collected and held by the Department of Education. I attempted to obtain the data set but would have had to fill out a license agreement and have my thesis adviser sign on as well. The dataset would have to be kept on a separate computer that did not have access to the internet. In addition to this dataset, an attempt was made to obtain the privately-funded New York City School Choice Program dataset. The principal collector of the data, Paul Peterson of Harvard, directed me to Mathematica Policy Research to receive it. Unfortunately, the same licensing process and a $30 fee were two requirements. The Georgetown Public Policy Institute was not willing to sign on to restricted use data for liability concerns. These two datasets would have made my model much stronger, my results more robust and precise, and my policy conclusions more prescient and better defined. School choice research and programs will play an important role in future discussions on education reform. Knocking down barriers and limiting restrictions to data is definitely an
important step.

Secondly, better collection of demographic variables for student participants in voucher programs is critical. The datasets I collected for this thesis came from the 1990s. School voucher program datasets may have been better collected over the last ten years, but I have no way to know for sure because of the acquisition problems noted above. The Milwaukee datasets contained a number of demographic variables that did not receive responses from either the parents or students responding to surveys about the program. There were a number of variables I wanted to include in my model to explain the variation in math and reading scores, including demographics about father’s race and education, class size, and school size, among many others. A requirement of answering specific demographic variable questions should be imposed on the students who apply for school vouchers to obtain better data for researchers and lowly graduate students. This requirement would result in better standardization of data across school voucher programs so comparisons could be made between multiple cities.

Thirdly, while my data has been severely limited by collection problems, the following specific policy results should be enacted: publicly-funded school voucher programs should be expanded across the nation. The choice variable (students who accepted the voucher) in the model was both positive and significant for both reading
and math. However, there have only been about a dozen school choice programs in the last twenty years. An increase in sample size will give researchers and policymakers access to better information on how well vouchers work. In addition, data for the Charlotte program were available only over one school year period while Milwaukee data was collected over a 5 year period. This fact points again to the first recommendation in data availability to researchers. An increase in the voucher award amount would result in a very small increase in math test scores, but no increase in reading test scores; it is therefore not clear such an increase is warranted. The value of adding an additional dollar to a voucher program will only result in an additional $\frac{5}{1000}$th of a point on math test scores. This magnitude is quite low. Fully covering the cost of a voucher may relieve some parents who worry about supplementing educational costs with their own money, but at the same time, forcing parents to bear some of the costs may get them more involved in their children’s lives and want to pick the best school. Also, variation of cost in the privately-funded Charlotte school voucher program was not available since only one year of data was provided. This fact points yet again to the first recommendation of data availability to researchers. The Charlotte variable, indicating that a student accepted and used the voucher in the Charlotte school choice program, was negative and statistically significant for both math and reading scores. This leads me to conclude that privately-run vouchers
systems are not inherently better than publicly-run voucher systems. When it comes to funding school choice programs, the amount of the school voucher must be increased in order to obtain better results. However, covering the entire cost of private school tuition is not entirely necessary. Spurring parental involvement by getting them to invest money in their child’s education will hopefully improve test scores as well.

Overall, the methods used to study these questions and make policy recommendations are severely limited. The number of school voucher programs as well as school voucher program researchers is inadequate to know for sure the best solutions to this country’s educational problems. Acquisition of datasets from Milwaukee, Wisconsin and Charlotte, North Carolina occurred for the most part without incident. Unfortunately, datasets from other areas of the country were unable too difficult to collect. I ran regressions to compare the difference between publicly-funded and privately-funded school voucher programs with regards to math and reading scores for recipients, which showed that privately-run systems do not necessarily perform better than publicly-run systems (although the data are too limited to be sure of this conclusion). In addition, I performed an analysis of the cost of each program tied to each student in both programs. The amount of money per voucher does not necessarily lead to large improvements in test score results. Nonetheless, school voucher programs cost much less per-pupil than the public schools in those
cities. In conclusion, an increased sample size of students, an expansion of the number of programs, and better acquisition of demographic variables will lead to more precise results and enable researchers to generalize their findings across the nation.
Students from the Milwaukee Parental Choice Program.
Chapter 8.   References and Citations


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