A MEASUREMENT OF CHARTER SCHOOL EFFICIENCY IN NORTH CAROLINA UTILIZING MODIFIED QUADRIFORM ANALYSIS

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ABSTRACT

Daniel C. Sturdevant: A Measurement of Charter School Efficiency
in North Carolina Utilizing Modified Quadriform Analysis
(Under the direction of Eric Houck)

Charter schools exist under the umbrella of public education, but are not subject to the same level of public oversight or accountability measures as traditional public schools in North Carolina and many other states (BiFulco and Ladd, 2006; Bettinger, 2004). There is a lack of easily accessible efficiency data on charter schools. The primary aim of this study was to establish if the modified quadriform analysis (MQA) could be used to assess charter school efficiency. Second, the study sought to assess relative efficiency within the population of charter schools in North Carolina, and to establish their rankings in context with one another, so that alterable school characteristics could be analyzed to see which contribute most to efficiency. The study employed the MQA, which is based upon plotting the residual data from a multiple variable regression of input and output variables, and then categorizing the graphed data based upon the input/output relationship. The study concluded that the MQA is a viable means for assessing charter school efficiency, and that efficient charter schools in North Carolina are correlated with higher pupil-teacher ratios, higher numbers of guidance counselors, and higher measures of community wealth.

DEDICATION

To Christa, Elsa Claire, Dad, Mom, Gramma, and Poppa. Thank you for your love, support, encouragement, and examples. I am extraordinarily blessed to be in such good company, and I love you all.

Christa, you are the best wife, mother, and partner I can imagine, and I never would have finished this without you.

Elsa Claire, I am so glad to be your Daddy. The hugs, kisses, and 'I love yous' were always exactly what I needed. I love you.

Dad and Mom, thank you for all you've done to push me, to hold my feet to the fire, and to support me. Dad, if not for you, I never would have been in education. Mom, you might be the best listener I know, and it always helps!

Gramma and Poppa, thank you for always encouraging me and praying for me. Without Poppa always pushing me to go further, I'm not sure I would have ever thought about an Ed.D. I know how fortunate I am to be your grandson. Thank you.

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CHAPTER 1: INTRODUCTION

Background Information

Charter schools are broadly defined and vary significantly from state to state, but basically, they "are privately managed, taxpayer-funded schools exempted from some rules applicable to all other taxpayer-funded schools" (www.nea.com). In 1988, Albert Shanker (then president of the American Federation of Teachers) suggested a school model "where teachers could experiment with fresh and innovative" curriculum and where they would have a greater say in the formation and function of the institutional model (Kahlenberg & Potter, 2014). The first such school opened in Minnesota in 1992, after the state adopted the first charter law in 1991. In 1994, the federal government revised the Elementary and Secondary Education Act (ESEA) (1965) to include a charter school option:

> The Charter Schools Program (CSP) was authorized in October 1994, under Title X, Part C of the Elementary and Secondary Education Act of 1965 (ESEA), as amended, 20 U.S.C. 8061-8067. The program was amended in October 1998 by the Charter School Expansion Act of 1998 and in January 2001 by the No Child Left Behind Act of 2001. The program, which provides support for the planning, program design, and initial implementation of charter schools, is intended to enhance parent and student choices among public schools and give more students the opportunity to learn to challenging standards. Enhancement of parent and student choices will result in higher student achievement, however, only if sufficiently diverse and high-quality choices, and genuine opportunities to take advantage of those choices, are available to all students. Every student should have an equal opportunity to attend a charter school (U.S. Department of Education, 2004).

Provisions for establishing, funding, and converting public and private schools into charter schools were included in the 1998 revisions of ESEA, and in the No Child Left Behind (NCLB) legislation of 2001. The federal government has aided states' efforts to expand charter schools

even though the standard of "an equal opportunity to attend a charter school" has not been met (NCLB guideline, 2001).

In the 25 years since their inception, charter schools have proliferated across the country. While the percentage of students served has increased steadily, issues such as faculty turnover, which is higher than traditional schools (Stuit & Smith, 2010), and lower rates of ethnic and economic diversity have plagued them (Podgursky & Ballou, 2001). Performance data (usually defined by standardized test scores) have shown some variation between traditional school models and charters, but on average the difference is nominal (Kahlenberg & Potter, 2014).

Charter schools are often associated with efficiency (Gronberg et al., 2012; Grasskopf et al., 2009) among other traits. The association with efficiency is a benefit to the charter school movement and is a difficult outcome to measure accurately because charter schools have widely differing models of instruction, hiring practices, and targeted student populations. Charter schools are independent operators within the school system, and are not subjected to customary comparisons and rankings as often as traditional public schools, which makes a study of their relative efficiency important and uncommon. Less oversight and accountability for results makes a study of their relative efficiency important and uncommon. A need within the academy of education finance research is a reliable and repeatable methodology for measuring the efficiency of charter schools. This study seeks to provide this methodology to examine and measure relative efficiency among charter schools in North Carolina.

The opening chapter of this dissertation offers information about charter schools in North Carolina as well as the rest of the United States, a brief overview of the political and social history of charters, and the problem of addressing efficiency.

Statement of the Problem

Charter schools exist under the umbrella of public education, but are not subject to the same level of public oversight or accountability as traditional public schools in North Carolina and many other states (BiFulco& Ladd, 2006; Bettinger, 2004). In addition, academic success is not the explicit mission of all charter schools. Many serve populations that are underrepresented in traditional public schools, while others serve populations that are by-and-large affluent and well represented in traditional public schools. Thus, there is a lack of easily accessible efficiency data on charter schools. The aim of this study was not to establish a normative efficiency measure or scale, but rather to assess relative efficiency within the population of charter schools in North Carolina and to establish their rankings in context with one another, so that school programs and policies may be assessed to see which contribute most to efficiency.

Significance of the Study

The problem of relative efficiency, and understanding it in the charter school sector, is important to investigate because charter schools are a growing entity in North Carolina and the nation. They receive large portions of public school money and have fewer obligations and accountability measures than traditional public schools. Locally, members of the North Carolina General Assembly (NCGA) have been very pro-charter for the past five years, and they indicate that they will continue in that direction (www.ncpolicywatch.com, 2015; 2016). In addition, North Carolina Governor Roy Cooper has highlighted the need for increased accountability and measures in his official platform ("NC Governor Candidates on Teacher Pay, School Spending, Pre-K, other Education Issues," Raleigh *News and Observer*, 2016). As the number of charter schools in North Carolina and the nation grows, it will become more and more important to accurately measure the return on such a significant investment and to establish which schools,

and thereby which programs and policies are most effective, so that better educational decisions can be made statewide.

Context of the Study

In 2011, the NCGA voted to remove the cap on charter schools, which had been set at 100. In 2014 alone, 26 new charters for schools were awarded (Khrais, 2014). As of the 2016-2017 school year, there were 167 brick-and-mortar charter schools and two virtual charters in North Carolina. In 2014-2015, those 169 schools served 57,926 students out of a total of 1.5 million, or just under 4% of the public school students in North Carolina (NC DPI, 2014).

In North Carolina, the General Assembly controls education policy, and has embraced charter schools as a means to:

> Improve student learning; Encourage the use of different and innovative teaching methods; Provide parents and students with expanded choices in the types of educational opportunities that are available within the public-school system; and Increase learning opportunities for all students, with special emphasis on expanded learning experiences for students who are identified as at risk of academic failure or academically gifted. (§NCGS 115C-218)

The movement is based on the desire of parents and voters for improved access to various educational models, to raise the bar for both the lowest and the highest achieving populations, and to encourage innovation within the teaching profession (§NCGS 115C-218).

While there have been several efforts to assess charter school efficiency in recent scholarship (Solmon et al., 2001; Eberts & Hollenbeck, 2002; Bifulco & Ladd, 2006; and Grosskopf et al., 2009), the modified quadriform analysis had not been employed. The quadriform is an analytical tool developed by Hickrod (1989) and adapted into the modified quadriform (Anderson, 1996), which allows relative efficiency to be determined and offers a distinct opportunity for charter schools to further their mission of transferring newly discovered or established instructional or policy practices into the traditional public school system. The

modified quadriform meets a need to understand the range of charter school performances by examining relative efficiency. Understanding efficiency in context allows researchers to identify particularly high- and low-performing schools, isolate effective practices, and determine if the schools within each quadrant have any common characteristics.

Modified quadriform analysis has been applied to large school districts (Stephens, 2006; Houck et al., 2010) and in statewide situations with positive results, and has enjoyed increasing usage since its first appearance (Anderson, 1996). Until now, it has not been applied to charter schools.

Purpose of the Study

The purpose of this study was to explore charter schools in North Carolina from the perspective of relative economic efficiency in order to understand the range of charter schools' return on investment. This information would allow researchers to identify particularly high- and low-performing schools, isolate effective practices, and determine if these categories of schools have characteristics in common. The study analyzed academic outcomes in the context of economic inputs to determine relative charter school efficiency. To determine relative efficiency, the modified quadriform was applied to the error results of a multivariable statistical analysis, and was utilized to establish quadrants of relative efficiency among charter schools in North Carolina. This study was also a proof of concept, as the modified quadriform has never been used exclusively to analyze charter schools. After a baseline of relative efficiency is established, the schools within each quadrant were analyzed to determine which alterable characteristics may have affected academic outputs. The study sought to establish a model for further investigation of charter schools using the modified quadriform.

The intent of this study was not to compare disparate school organizational models, but to

thoroughly examine the model that utilizes public money with the least oversight, i.e., charter schools. For purposes of this study, academic achievement was the dependent variable, and for lack of a more ubiquitous alternative, that was defined by the performance composite of the North Carolina Accountability Program, or ABCs.

Research Questions

The primary research questions of this study are:

1) Can the modified quadriform be used to evaluate the relative efficiency of charter schools? (A positive outcome would be measured by high Adj-r^2 values and similar quadrant distributions as shown in other studies.)
2) How economically efficient are charter schools in North Carolina in terms of financial inputs vs. academic outputs?
3) What alterable characteristics contribute to the relative efficiency/inefficiency of charter schools in North Carolina?
4) Is the modified quadriform analysis a potentially beneficial means of evaluating charter school efficiency?

Hypothesis

The modified quadriform was used to identify the most relatively efficient charter schools in North Carolina. The study then employed a discriminatory analysis of descriptive statistics to compare the most efficient charter schools to other, relatively inefficient charter schools in the sample population. The primary hypotheses of the study were that relatively efficient schools will have: 1) fewer high-poverty students, 2) more guidance counselors, 3) a lower teacher-to-pupil ratio, and 4) a higher community wealth rating than relatively inefficient schools.

Previous national studies find a wide range of charter school performances, mediated by factors such as race and socio-economic status (SES). I hypothesize that schools with relatively low racial diversity and high SES will be associated with greater efficiency and show sensitivity to these variables that is like traditional public schools (Alexander et al., 1994; Bali & Alvarez, 2004). charter Many North Carolina charter schools are relatively new entities, and there is a learning curve before optimal efficiency is reached. Thus, in all probability the schools in this study will fall mostly into inefficient or ineffective quadrants. In the interest of full disclosure, the author did wield some influence on the numbers (based upon the size of the "hold-harmless" area selected, which are discussed in chapters 3 and 4 in detail), but he endeavored to follow best practices established by previous study authors: Hickrod (1989,1994), Anderson (1996), Rolle (2004), Rolle, Houck, and He (2010) and others.

Conceptual and Theoretical Framework

Conceptual Framework

Springer, Houck, and Guthrie in *Handbook of Research in Education Finance and Policy* (Ladd & Fiske, 2013) establish a set of three modern public values of education finance policy: equity, efficiency, and liberty. While the pursuit of any of the three by itself is worthwhile, doing so may impede the ability of the remaining two to be realized effectively. Each value exists in tension, but also contains its own, separate line of inquiry. Guthrie and Wong (2013) give the pursuit of efficiency high value, especially as it pertains to schools, but if it becomes the primary goal, it may severely restrict liberty and equality, and diminish the overall product. As school budgets are resource constrained, efficiency is always a factor in evaluations and analyses, and since charters are supposed to receive lower funding than traditional public schools (by law and design), knowing how funds are spent and if that spending is efficient is important.

This study seeks to examine the value of efficiency, and its associated line of inquiry, as it pertains to charter schools in North Carolina.

Theoretical Framework

Schools are complex and distinct institutions, and not all of them hold the same primary and secondary values/goals within their communities, and especially across communities and states, making a standard measure difficult. Previous efficiency research focuses on the input/output relationship, and determines technical efficiency based on units of production (Hanushek 1997, 2007; Bifulco, 2001). This study chooses instead to focus on relative efficiency through implementation of the modified quadriform. The modified quadriform assesses the efficiency of schools relative to one another rather than an objective standard of technical efficiency.

Houck, Rolle, and He (2010) specified the advantages of the modified quadriform as follows:

> A quadriform is an abstract tool devised to allow relative relationships between inputs and outputs to be viewed both graphically and quantitatively. By comparing residuals of input and output oriented regression equations, the quadriform contextualizes performance into a relative rather than an absolute framework.

The modified quadriform allows for the interpretation of schools for what they are— highly contextualized entities. Interpreting schools in the context of relative efficiency allows for secondary, discriminatory analysis of alterable characteristics. Following multiple regression analysis, schools were placed in one of four quadrants based on the residual values calculated (See Figure 1.1).

Figure 1.1: The Modified Quadriform

Inefficient	Effective
Ineffective	Efficient

Assumptions and Limitations

Assumptions

1. By conforming to §NCGS 115C-218, it was assumed that all charter schools have common purposes that define how they operate. As such, academic performance would be a priority.
2. It was assumed that the per-pupil expenditures (PPE) were accurate and did not reflect any significant unreported expenditures or significant in-kind gifts of services or materials to the institution that would skew the results.
3. It was assumed that the composite performance score of the NC ABCs wasa valid measure of student achievement and accurately reflected institutional policies and practices.

Limitations

1. This was a one-year, proof-of-concept study, and does not afford the clarity of data trends or student growth/regression of a longitudinal study.
2. The measure for county affluence was accurate for the county, but individual schools may be located in much more or less affluent area than the county average, meaning that the affluence of individual student bodies may differ from the county average.

Definition of Terms

Alterable school characteristics: school variables that are more open to change such as teacher-to-student ratios, teacher salaries, and the amount of funding allotted for various programs (Anderson, 1996; Stevens, 2007).

Educational efficiency: the optimal use of educational resources, which results in student achievement (Anderson, 1996; Stevens, 2007).

Modified quadriform: The modified quadriform interprets the input-output relationship of selected variables in two separate linear regressions to delineate efficient and inefficient school districts. The model then uses discriminant analysis to distinguish what alterable school characteristics differ between the efficient and inefficient schools (Anderson, 1996; Stevens, 2007).

Production function research: identifying patterns and relationships of inputs and outputs (Anderson, 1996; Stevens, 2007).

Student achievement: School performance composite scores on the 2012 North Carolina ABCs (Accountability Program).

Unalterable school characteristics: Demographics of students and schools that school officials have little control over such as total district enrollment, percentage of economically disadvantaged students, percentage of special education students, percentage of minority students, and local tax base value per pupil (Anderson, 1996; Stevens, 2007).

CHAPTER 2: LITERATURE REVIEW

This chapter reviews the history of efficiency studies in education and examines two prominent movements within education finance research: cost-benefit analysis and the "does money matter" research movement. Subsequently, the chapter examines the literature concerning the establishment of charter schools and previous studies of their efficiency and performance. The review incorporates literature and research relevant to specifics of the charter school movement both nationally and in North Carolina. The chapter concludes with a summary of available school efficiency techniques, including both the modified quadriform and other techniques not selected for this study.

In 2004, Rolle published a study that asked the question, "Does money matter?" He offered evidence on both sides, ultimately concluding that money is not the most important factor in measuring school efficiency, but rather the maximization of existing resources. Citing research from the 1980s (Kirst, 1983; Hanushek, 1986), Rolle makes an effective case that money is not as important as teacher training and education, and most importantly, experience. Rolle evaluates whether money does matter via a cost-benefit analysis, often called effective schools research (Rolle, 2004). It is largely based on the research of Laine, Greenwald, and Hedges (1994), Odden (1986), Murphy and Hallinger (1986), and Rossmiller (1987). They assert that there is a correlation between how much financial input a school receives and the level of output it can produce. Going further, Rolle offers three evaluative lenses for researchers today to employ, including the modified quadriform, which does not measure if money matters, but

rather how it matters. Through specification of a quadrant and a secondary discriminant analysis, the modified quadriform highlights how money is spent, putting the focus upon allocation rather than amount, at least in financial terms.

The structure of the literature review was informed by both the nature of this study and of charter schools and their structures and goals. First, this study sought to measure relative efficiency within the charter school sector. To do so, calls for a discussion of efficiency measures within education and charters themselves. Second, the charter school movement is linked to higher efficiency and is designed to secure efficient educational outputs. Thus, investigations of charter school development, efficiency and outcome studies, and funding mechanisms for both traditional public schools and charter schools are germane and important.

Introduction to Early Efficiency Advocates and Implementation

Cubberley and Taylor Usher in a Business Mindset

Early efforts at educational efficiency were based on a factory model of production efficiency; the more prepared and satisfactorily achieving students a school produced with the least financial input, the better. Born out of efforts to improve factory production as the United States approached the end of the second industrial revolution, the gray areas of education—different learning styles, paces, or even demographics of the students and teachers—were not considered. Human capital was treated the same as financial or material capital in the process of analysis (Callahan, 1962).

The nascent discipline of "scientific management" or "the Taylor System" pushed the ideals held by Cubberley (1906), among them, an emphasis on school funding efficiency (Taylor, 1911). Named for Frederick Winslow Taylor—and originally designed for improvement of factory production—the practice of scientific management inspired an entire subset of the

population to become professional managers, not trained specifically in a trade, but in the practice of managing others. Despite the vast differences between manufacturing and education, in 1911 the National Education Association (NEA) endorsed the principles of scientific management for management of educational systems (Miller, 2002). The educational-industrial management connection had not been made in scholarship, and it was a watershed moment for the practice (Callahan, 1962).

After Taylor introduced scientific management principles to the world, the question of "how is efficiency measured" was widely asked. To complicate matters, the answer is highly industry specific, and the measure can vary from an analysis of the employee (a teacher in this case) to an analysis of the product (a student) or nearly anywhere in between. Taylor's ideas are the bedrock of modern efficiency studies, but his influence is diminished in times of public plenty (Ibid). However, when a recession or depression strikes, Taylor's principles come roaring back into the political, economic, and educational discourse; efficiency becomes the pre-eminent social value, at least temporarily.

In *Stretching the School Dollar,* Hess and Osberg (2010, p. 2) argue that recessions, like the 2008 financial downturn in the United States, create a climate in which district leaders ask how schools can "boost efficiency and promote reform?" The result is the conspicuous conclusion that reforms can often be cost-saving measures that are designed to lessen the budget without harming overall student performance on standardized measures. Examples include: limiting sports, cancelling arts, and refraining from new textbook purchases.

Simon Patten: Efficiency as a Comparative Exercise

The drive toward efficiency in education was hampered by the lack of an objective measure for output. Factories had production numbers. Farmers had yields. Teachers and

administrators, however, had a subjective product under significant scrutiny, and not always with consistent expectations and standards. Researchers and practitioners searching for a measure decided on standardized testing as the solution for efficiency measurement in education (Callahan, 1962).

Thus, the drive toward efficiency increased the use of standardized testing. As Taylor's ideas spread, the public focus shifted to increases in profit and output, and teachers and administrators came under fire. In May of 1911, Simon Patten wrote in the *Educational Review* that "the advocate of pure water or clean streets shows by how much the death rate will be altered by each proposed addition to his share of the budget… only the teacher is without such figures" (Ibid.). Patten contended that public school systems unable to show their merit in measurable ways should not be funded over other public entities that could. Ultimately, he argued that schools could only answer his challenge by showing results that could be "readily seen and measured" (Ibid). Patten fed the fire of "reform" in schools and created a climate in which critics of education were equipped to demand reforms that created unnecessary and illogical burdens of proof—especially in the humanities. As a result, instructional time was replaced with testing, and a factory efficiency approach was implemented in a non-industrial endeavor.

The development of the tests (Patten's call for "numbers") was left to the NEA, which developed a Committee on Tests and Standards of Efficiency in Schools and School Systems. At NEA's national conventions in 1913 and 1915, this committee recommended increased scales and measures to allow comparisons among and within schools. To create tests and scales of comparison, several firms of "efficiency experts" were employed as were numerous university professors of education. So popular was the endeavor that a National Society of Efficiency Men

(Ibid) was established, and gender exclusivity notwithstanding, it was a prestigious membership counted among the national council of superintendents. The suggestions from this group were not strictly limited to testing, however, and ranged into teacher conduct and preparation. Teachers, the committee asserted, "should have a well-stocked satchel [with paper and pencils, etc.] and carry it from room to room in case it is needed." (Ibid). Additionally, basic classroom tasks were measured for efficiency, such as taking up and passing out papers and tests, and these menial tasks were graded and timed.

ESEA, The Coleman Report, and *A Nation at Risk:* Efficiency as Allocation of Resources

After the launch of the Soviet satellite Sputnik, the U.S. government became concerned that its education system had not produced scientists capable of winning the space race, and several studies were commissioned to see what could be done about it. Contextualized by the space race, arms race, and the myriad crises of the 1960s, the first publication to come out of the studies, the *Coleman Report* (1966), created widespread concern regarding public education in the United States (Rolle, 2004; Standerfer, 2006).

In the 1960s, 1970s, and the early 1980s, the drive toward efficiency temporarily shifted into a panic with the publications of both the *Coleman Report* in 1966 and most significantly, *A Nation at Risk* in 1983. Both reports cited significant concerns about the efficacy and ability of the public education system's ability to properly teach its students. The passage of the ESEA in 1965 had invested significant government resources in the education system, and had resulted in an increased desire for financial accountability. Within a few years, the National Assessment of Educational Progress (NAEP) was implemented to further assess student learning. Initially, scores were reported on a regional basis, with the intent to make general comparisons rather than

specific, state-to-state comparisons. However, by the end of the 1970s, the ESEA reforms had not closed the achievement gap as hoped (Standerfer, 2006).

In 1966, James Coleman and his team of researchers, commissioned by the Civil Rights Act of 1964, published the eponymously titled report, *Equality of Educational Opportunity*, and caused national alarm. The 746 pages detailed an alarming lack of quality and equality within the U.S. public school system. While the report did not immediately generate concerns about efficiency, it did bring about significant change in equity and access within the school system. Less than half a decade later, Swann v. Mecklenberg County (1971) was decided in the U.S. Supreme Court; it mandated busing to integrate schools, especially across the South, the region where Coleman's statistics showed the most egregious inequities.

The mass of data collected by Coleman and his colleagues allowed them to draw conclusions that were previously not possible, some related to efficiency. Per Gary Burtless (1996), Coleman's investigation revealed that the differences among resources available to black and white students were smaller than supposed in several areas, and in most other measurable statistics. The resulting sea change throughout public schools created a new urgency to measure efficiency, as per-pupil expenditures were far more racially diverse than previously thought.

Nearly 15 years later, *A Nation at Risk* (1983) created a public stir when it cited alarming statistics such as: "fewer than one-third of U.S. high schools offer physics taught by qualified teachers," and "minimum competency examinations (now required in 37 states) fall short of what is needed, as the minimum tends to become the maximum, thus lowering educational standards for all." Partially owing to the publication of *A Nation at Risk,* the National Center for Education Statistics reported that federal funding for elementary and secondary education fell by 21% between 1980 and 1985. After the hundreds of millions that had been spent through the ESEA,

the reports' findings of failing schools and American students falling behind the rest of the world sent the message that increased spending was not the solution (Standerfer, 2006).

Another effect of the findings reported in *A Nation at Risk* was the expansion of NAEP testing and an increase in comparisons. Secretary of Education William J. Bennett hired the Alexander-James group to study and make recommendations on how the NAEP could be utilized to increase accountability through comparisons. Shortly thereafter, under the leadership of President George H.W. Bush, national content standards were created for each core subject (Standerfer, 2006). President Bill Clinton continued the trend with the Goals 2000 legislation and a reauthorization of ESEA under the new name of "Improving America's Schools Act." This act mandated that states must create standards in core subjects that will be assessed (Standerfer, 2006).

Eric A. Hanushek and Contemporaries: Efficiency in Production

Building upon the national attention garnered by *A Nation at Risk,* Eric A. Hanushek (1986) argued in *The Journal of Economic Literature* that there is no statistically significant link between student outcomes and district expenditures. As an economist, Hanuskek's view was relatively new, and created a sub-field of inquiry among his economist peers. His work was well regarded among economists, and remains the prevailing view among those who study education finance (Burtless, 1996). Augmenting his research was a study by Chubb and Hanuskek (1990), that detailed the rise in expenditures beginning in the Johnson Administration and the corresponding fall in student performance. Specifically, between 1966 and 1980, student performance (as measured by the SATs) dropped as teacher pay increased by half, per-pupil spending tripled, and the student-to-teacher ratio fell by more than a third.

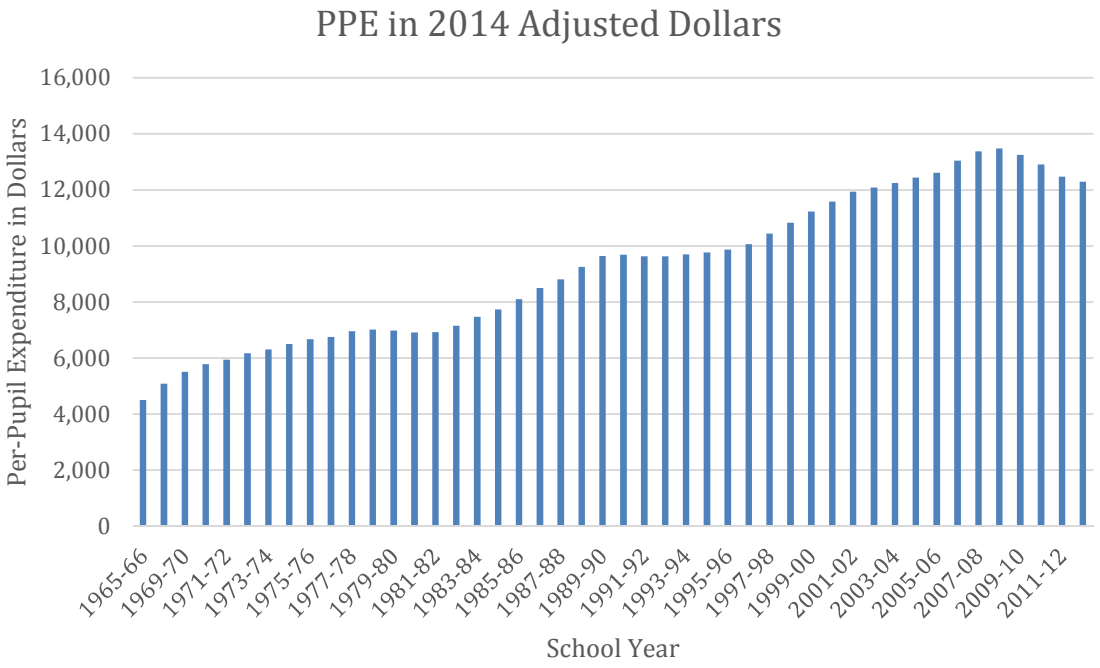
However, it is worth noting that following the 1983 publication of *A Nation at Risk,* the direction of student achievement changed, and by the latter part of the 1980s. It remains true, however, that since the 1960s, the United States has fared significantly worse than it once did on all international achievement tests in comparison to other nations (Burtless, 1996). There are several reasons this may be true. First, it may be that the United States was the first nation to invest significant sums of money into education and it enjoyed an initial jump in quality that has been since matched (or approached) by other nations over time. Second, the United States has experienced significant population growth since 1960, the year that marked a peak population growth rate internationally. Most other nations have not experienced this rate of growth, making educational development a smaller scale project (Ortiz-Ospina & Roser, 2016). Greenwald and Hedges (1996) say that the drop may not, in fact, be as precipitous as it first appears, and could be attributed to changes in the student population demographics. They contend thatthe addition of many different kinds of students, such as English Language Learners (ELL) and Exceptional Children (EC) as the result of court cases throughout the 60s and 70s focusing on access, put increased demands on the education system.

Most relevant to this investigation, however, was a conclusion from Hanushek's 1996 article *School Resources and Student Performance* in which he argued that spending money on education is a reasonable and expected cost, but it is worth investigating as "the existing evidence simply indicates that the typical school system today does not use resources well." The amount of money spent on education (especially in the wake of *A Nation at Risk*) increased dramatically and significantly outpaced academic gains.

For perspective, as all of these efficiency measures and reports were developed, and the study of education continued to evolve in both process and methodology, per Guthrie and Peng

(2010) the rate of per-pupil spending (even when adjusted for inflation) rose in nearly every year since Taylor's publication in 1911. The rate of spending did not dramatically change salaries (ironically, as that is what Taylor would likely have advocated), but it did dramatically increase both instructional and support staff and technology in schools. As a result of the focus on school finance, the drive for student performance, and the desire for a good return on investments, education has become one of the largest expenditures of all levels of government in the United States. Per-pupil-expenditure (PPE) has increased four-fold since 1966 (see Figure 2.2).

Figure 2.1: Per Pupil Expenditures in 1965-2012



SOURCE: U.S. Department of Education, National Center for Education Statistics, *Biennial Survey of Education in the United States*, 1919-20 through 1955-56; *Statistics of State School Systems*, 1957-58 through 1969-70; *Revenues and Expenditures for Public Elementary and Secondary Education*, 1970-71 through 1986-87; and Common Core of Data (CCD), "National Public Education Financial Survey," 1987-88 through 2012-13. (This table was prepared September 2015.)

In 2004, when Rolle asked if money mattered, he qualified the question by considering and defining "technical efficiency" and "allocative efficiency."

> Technical efficiency is achieved when either (a) output levels cannot be maintained with lesser amounts of inputs or (b) output levels cannot be increased while holding inputs constant. Allocative efficiency is achieved when all input resources are exhausted while producing any amount of output. In other words, an entire education budget is spent in an attempt to deliver as many desired services as possible. (Rolle, 2004)

He goes on to assert that while there are many education finance research studies, most of them concern the study of inputs and the effect they have on outputs and/or educational production outcomes. This discussion introduced the two conclusions that have been reached by most researchers:

> • Money Does Not Matter. There is no economically efficient relationship between educational expenditures and outcomes.
> • Money Does Matter. There is an economically efficient relationship between educational expenditures and outcomes.

In arguing that "Money Does Not Matter," Rolle utilized a review of Coleman (1966), Jenks (1972), and related state and federal level budgetary decisions, to build a context for the debate. He included the efforts of *A Nation at Risk* at refocusing the debate on the economic consequences of low-performing schools, and the formation of a conservative coalition to increase spending to achieve better results. These efforts were ultimately tempered by Hanushek (1995, 1996), who asserted that the only correlation between school expenditures and student success came through years of teacher experience, and that hiring and retaining long-term teachers was the way forward.

To argue that "Money Does Matter," Rolle offered evidence that schools can and do produce economically efficient outcomes. Effective schools research, also emerging from Coleman's research (this time his 1966 eponymous report) and focused upon efficiency. Citing

Odden (1986), Murphy and Hallinger (1986), and Rossmiller (1987), Rolle argued that the focus on production-function relationships between funding and outcomes was myopic, and that additional funds would improve educational output (Rolle, 2004). Rolle went on to include Laine, Greenwald, and Hedges's (1994) re-analysis of Hanushek's (1981) meta-analysis, and found that more funding did in fact increase educational outputs, and scholars who based their analyses on Hanushek's conclusions should be cautious. Rolle concluded t with a reference to Cooper (1993, 1994) reminding readers that a true production-function for education is yet to be discovered, and the way schools use their resources is essential to understanding the relationship.

He goes on to investigate several methods of assessing efficiency, and concludes that legislative goals, oversight mechanisms, and policies are more affective of educational efficiency than money (in this case PPE). Rolle offered his thoughts on future directions for educational productivity research, highlighting public choice approaches, the modified quadriform analysis, and data envelopment analysis. It is worth noting that since Rolle concluded that money does not matter as much as legislative oversight in achieving efficiency, charter schools (which are relatively free from oversight) should be especially efficient, and the places where programs, policies, and curriculum best foster efficiency.

Charter Schools: History and Growth

There have been forms of publicly funded education in the United States since the Puritans founded Boston, but charter schools are less than a generation old. Entering the educational arena just before the explosion of the internet age, charter schools have experienced rapid growth across the nation. A key to understanding the need and importance of this study is a working knowledge of the original intention and proliferation of the charter school model.

A charter school is an institutional paradigm that was established by two schools in 1992 in St. Paul Minnesota (Bettinger, 2004). Since then, the growth of the charter model has been phenomenal. By 2001, less than a decade after the inception of the paradigm, there were nearly 2,400 charter schools operating in 34 states (NCES, 2016). In 2017, 43 states and the District of Columbia had charter school laws on the books, and the number of schools has grown to nearly 7,000, with more coming in the next year. Charter schools have enjoyed significant growth, by almost 400 schools, even as the number of traditional public schools fell by nearly 200 in 2012-2014 alone.

Figure 2.2: Growth of Charter Schools in 2000-2014

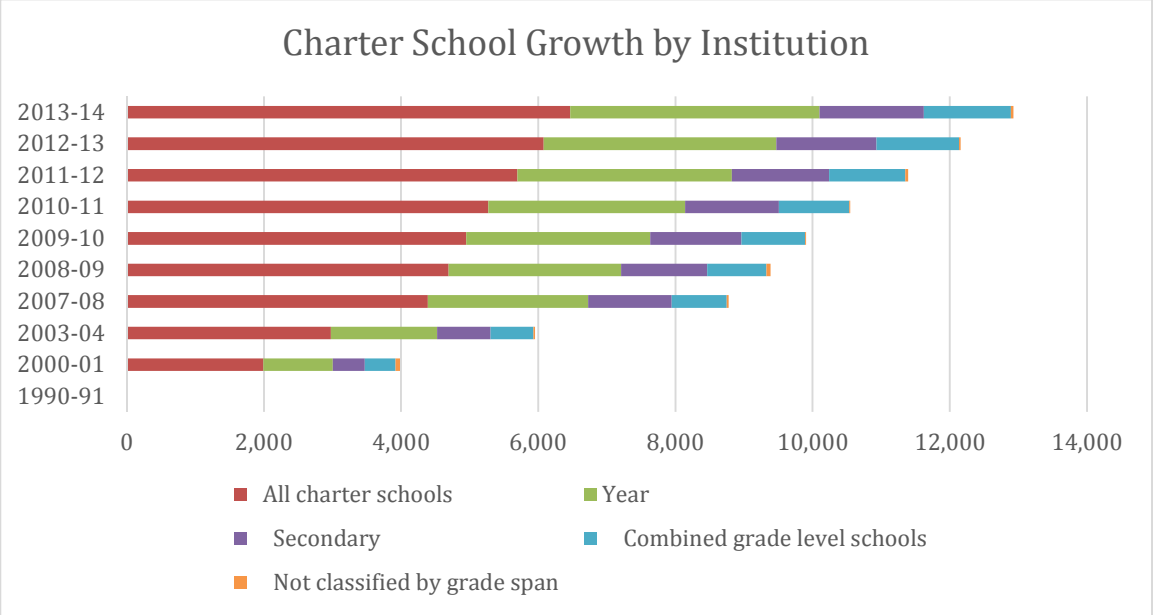
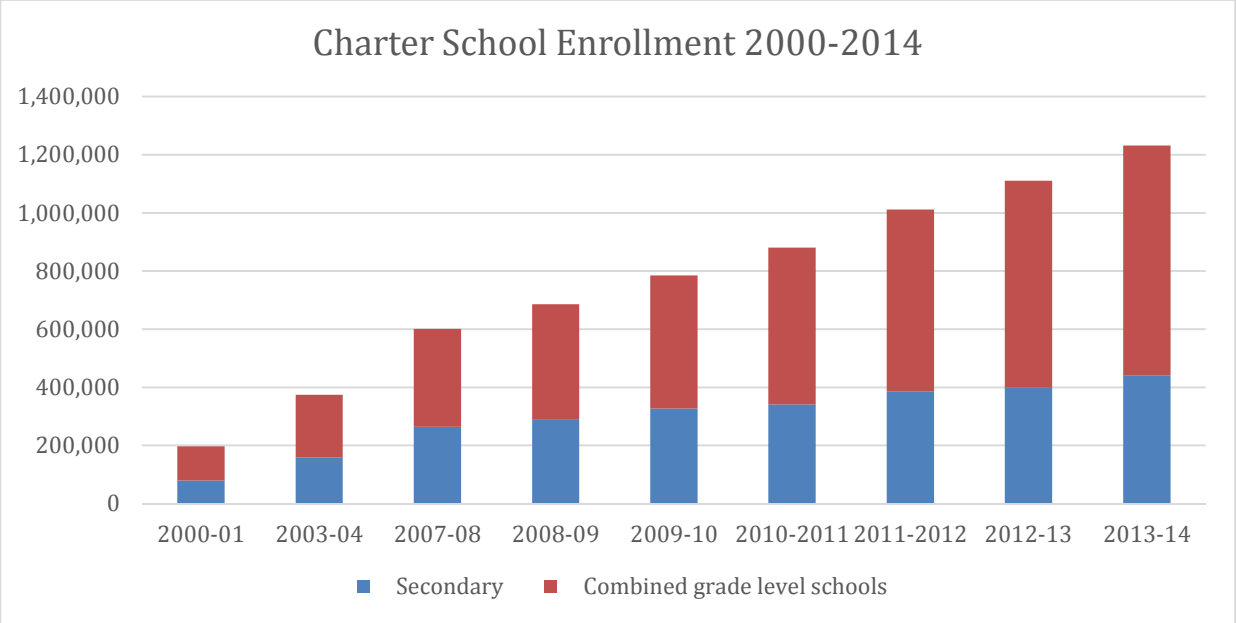


Figure 2.3: Growth in Charter School Enrollment in 2000-2014



Source: NCES, https://nces.ed.gov/programs/digest/d15/tables/dt15_216.20.asp

Charter schools exist in several different models—not-for-profit, for-profit, independently managed, or managed by an Education Service Provider. Different states allow for all of these forms or a combination of forms, and several policy groups (pro-charter and anti-charter) rank states based on their charter school laws. National Alliance for Public Charter Schools is one such policy group and has an extensive report card system available online at http://www.publiccharters.org/get-the-facts/law-database/states/NC.

Many charter initiatives involve considerable political maneuvering (Bettinger 2004). The state of Michigan provides a relevant example of an early and large-scale adopter of charter schools (heavily influenced by U.S. Secretary of Education Betsy DeVos). A central focus of Michigan's charter school initiative, and one that added legitimacy as well as volume, was to encourage the creation of 150 charter schools that would be sponsored by state colleges and universities, regardless of geographic proximity. Of the 150 university-sponsored charter

schools, all were approved by the 10 state universities' boards of trustees. This allowed then Governor John Engler, who approves all appointments to these boards, to politicize the process. Driving the point home, in 1998, Eastern Michigan University announced it would not sponsor any charter schools, and shortly thereafter was informed that the state legislature proposed cuts to its budget. EMU trustees reversed their position, and the cuts never came (Bettinger, 2004). Soon after, most universities abandoned attempts to keep charter schools in close geographic proximity, opting to open as many as possible as quickly as possible, to respond to existing and increasing political pressure.

In Michigan, home to some of the most flexible charter school laws in the nation (Bettinger, 2004), 170 charter schools opened within the first five years of eligibility (1994-1999), and accounted for 3% of all student enrollment in the state by 1999. Any non-religious group in Michigan can apply for a charter, "including existing public and private schools." To gain approval, a charter is required to establish academic goals for the next seven years. However, in the first seven years of the charter school program, only two of nearly 200 schools were closed for failure to meet their goals.

Another large-scale adopter of charter schools is the New York City Public School System, where the conversion rate of public schools to charters has been astounding. With encouragement by recent mayors, including Rudy Giuliani and Michael Bloomberg, charter schools have become a flagship component of the public school system in the city. Per the *New York Daily News*, in 2012-2013 there were 59,000 students in NYC charter schools vs. only 2,400 in 2002-2003, an increase of 2,328%, and the number of students enrolled in "publicly funded, privately run charters" climbed to 70,000 the following year (Chapman, Rex-Brown, 2014). In New York, charter schools can be not-for-profit or for-profit, and institutions of each

persuasion are utilizing the physical space of former public schools that were failing, and then 'privatized' to create charter schools. In all, New York requires five separate entities (three state and two federal) to give input on the status of a charter school's actual charter to operate, and a charter is good for three to five years. Charters can be revoked for misconduct or failing performance.

The success of the NYC schools is debatable, and there is a significant amount of information publicly available. The New York City Charter School Center (NYCCSC) is a repository, on the pro-charter side. The center publishes extensive information on its website (http://www.nyccharterschools.org) and offers explanations about many common concerns such as governance, accreditation, and fiduciary oversight. The website also touts significant gains for charter students over their public counterparts in math and reading, converting the gains into a unit of "additional school days" (ASD) worth of instruction. The NYCCSC assertion of increased performance is backed by the most recent report from the Center for Research on Education Outcomes (CREDO) at Stanford University. In a March 2015 report, charter students, particularly in urban areas, were found to be gaining ASDs over their public school peers, and the relative gap in performance has increased of late (CREDO, 2015). This allows for the argument that the longer charter schools are in existence, the better they respond to the market, become more effective, and raise achievement levels.

Renzulli and Evans (2005) clarify the basic arguments both for and against charters:

> Although they are public and secular, they elude the bureaucratic constraints of school districts, thereby evoking controversy. Proponents argue that charter schools significantly improve public education because they create: (1) choice in curriculum, structure, and discipline; (2) accountability for educational outcomes and student progress; and (3) autonomy for teachers, parents, and administrators. Proponents suggest that bolstering choice, accountability, and autonomy will result in high quality schools for all children, most notably those of poor and minority backgrounds (Nathan 1996). Opponents, in contrast, fear that charter schools cannot fix broader educational

> problems, and, if anything, are instruments of elitism and deplete public school resources (Alexander, 1997; Berliner and Biddle, 1995; Cobb and Glass, 1999.)

This is the primary tension and question of charter schools. Do they improve performance, demand efficiency, and benefit the most vulnerable student populations, or do they promote elitism, detract from educational opportunities and resources, and further inhibit the education of the most vulnerable students in schools? While diversity, equity, and access are well studied, the primary investigation here is the existing tension within charter schools over student performance, measured in efficiency, an area in which charters are thought to excel.

However, measuring efficiency in charter schools presented several challenges, as some schools are focused on specific areas related to their mission (or actual charter); their level of funding from state and Local Educational Administrations; their external fundraising (often more elaborate and "compulsory" than traditional public schools); and a lack of auxiliary programs found in traditional public schools such as athletics, special education, facilities for physically disabled students, and transportation services, which naturally skews the applicant pool (Ladd & Fiske, 2013; [Bifulco & Bulkley 2007]).

Politics and the Growth of Charter Schools

A main argument for the pro-charter movement in America concerns the establishment of "competition effects." Eminent researchers, such as Carolyn Hoxby (2003), argue that the establishment of charters and other publicly available (read: funded) school choices incentivize all schools in a district to become more efficient and productive through the creation of an educational marketplace. While education as a marketplace is a debatable concept, since the 1962 publication of Milton Friedman's *Capitalism and Freedom*, a strong social movement has advocated the need to examine education as a commodity subject to market influences. In Chapter 6 of *Capitalism and Freedom*, Friedman asserts that a truly free society would allow

public educational funds to be directed to the school (public, independent, parochial or secular) at the discretion of the students and/or the students' parents. Additionally, viewing education as a commodity in a marketplace allows for isolation of the social values previously mentioned, and the elevation/descent of each per "market forces," allowing for any of the three (in charter schools, most often it is efficiency) to rise to the top of the proverbial heap.

Friedman's work created national interest and momentum toward voucher programs, but more importantly, it expanded a national conversation that has since produced the *Coleman Report*(s), *A Nation at Risk*, and has influenced in obvious and subtle ways policies such as as No Child Left Behind and Race to the Top. Friedman's work also changed the literal terms of discussion surrounding education policy; scholarship such as Arthur Okun's (1976) economic efficiency tradeoff argument became directly applicable to the education system discussion and influenced policy and funding decisions.

Efficiency in schools had been inextricably tied to market economics beginning with Adam Smith (efficiency = profit). Increasingly, efficiency, which is becoming synonymous with innovation, is now the end goal. A major consequence of this shift in focus is the growing trend of deregulation as an educational reform, the tension it creates between advocates for deregulation and those who favor traditional organizational models, and the difficulties and inequalities created when public money is used to pay tuition at independent, parochial, or charter schools outside the purview of LEAs.

Deregulatory reforms such as vouchers (called Opportunity Scholarships in North Carolina, NCGA House Bill 944), the rise of charter schools, and increased teacher evaluation based on high-stakes testing have brought about a vibrant debate over which type of institution is, in fact, the best. Of course, the debate over what is "best" begs several questions. What

metric is used to determine performance? Is the hoped-for outcome measurable; is it short-term, longitudinal, individual, corporate, or specific to one demographic? What is the baseline? Can it be a true "apples-to-apples" comparison?

David Hursh (2007) argued that the impetus for the growing trend of deregulatory reform in public education is the result of an increasingly globalized world, the need for American students to remain competitive, and the idea that deregulation and unrestricted market forces (like Alan Greenspan's economic policy of the 1990s and 2000s) would benefit everything in the public sector—education included. The fear of American students being underprepared was, and is, very real, and has been spread by influential deregulation advocates such as Friedman. Friedman's influence through his regular column in *The New York Times* and multiple best sellers including *The World is Flat* (2005), and *Hot, Flat and Crowded* (2008) is seen in the millions of copies sold around the world. He sums up his view of the issue of American education in a 2005 column for *The New York Times* as follows:

> We need to get going immediately. It takes 15 years to train a good engineer, because, ladies and gentlemen, this really is rocket science. So, parents, throw away the Game Boy, turn off the television and get your kids to work. There is no sugar-coating this: in a flat world, every individual is going to have to run a little faster if he or she wants to advance his or her standard of living. When I was growing up, my parents used to say to me, "Tom, finish your dinner—people in China are starving." But after sailing to the edges of the flat world for a year, I am now telling my own daughters, "Girls, finish your homework—people in China and India are starving for your jobs."
>
> I repeat, this is not a test. This is the beginning of a crisis that won't remain quiet for long. And as the Stanford economist Paul Romer so rightly says, "A crisis is a terrible thing to waste."

He was concerned that the generation coming of age in the developing world, armed with only an internet connection, could disrupt our entire economy and steal our children's, and our own, jobs. He offered little instruction on how to achieve this improved education, other than working harder.

However, Friedman did not need to offer much direction, as the ball was already rolling in a specific direction. The 1997 report, *Public and Private Schools: How Do They Differ?*—commissioned by then U.S. Department of Education Secretary Richard Riley and written by Susan Choy—offered the following insight to educational reform:

> Because private schools are often perceived to be more successful in teaching students, with at least some empirical basis, many reform proposals for public schools have looked to the private sector for models to emulate. School choice, small schools, and decentralized decision making, for example, are among the features commonly associated with private education that many have suggested might benefit public schools. (Choy, 1997, p. 1)

What is immediately evident is that the reforms mentioned are all types of deregulation. Choy's 1997 report aligns well with Hursh's (2007) argument that the deregulation trend in all public sectors has been advancing since the end of WWII and peaked in the 1990s and early 2000s with the second Bush presidency. It is important to clarify, however, that Hursh was not asserting that deregulatory education reform is merely a Republican ideal. In fact, a deregulatory approach to education was cemented with bi-partisan approval in 2002 when No Child Left Behind passed the House with more votes from Democrats than Republicans, 197-185 (congress.gov).

Per Choy (1997), public schools have historically, and with "empirical evidence," been looking to non-public schools for reform initiatives. Placing Riley's assertion in the context of a deregulatory political environment, "those who fail are held to have made bad choices. Personal responsibility means nothing is society's fault. People have only themselves to blame… the market becomes central within such a conception of the individual," (Hursh, 2007, p. 497) has led to our current educational and political climate wherein public schools have become more like independent schools, autonomous and free of bureaucratic regulations. Also, Riley and Choy (1997), in a second publication, *Trends in International Math and Science Study,* cited the need for greater achievement in secondary education by pointing out the precipitous drop in

scores from 4th-12th grade U.S. students compared to the international average, in a foreshadowing of Friedman's (2005) logic. The perceived weakness of secondary education only added fuel to the argument for deregulation.

Given that this is the direction that educational reform is taking (many recent presidential candidates supported a deregulatory agenda in education), it is of paramount importance to determine just how great the organizational/structural differences are between independent/parochial/charter schools and traditional public school, especially regarding student achievement. Deciphering anecdote from objective investigation is more difficult in the current political environment, and that numerous Political Action Committees and "think tanks" have waded into the debate only further muddies the waters.

Independent and parochial schools have been around for centuries in the United States, and have existed exclusively within a market context. To achieve results (or the perceived results) similar to traditional market-based schools, efforts aimed at deregulating education and allowing the market to create efficiency and positive outcomes has led to the public-private option: charter schools. Charter schools rely on public money to operate, but do so outside of the purview of elected boards of education and their appointed superintendents. Some states allow charter schools to operate on a for-profit basis, revealing a true market-driven approach that rewards efficiency and student success. In charter schools, achievement scores and college admissions are measures of effectiveness, and also drive the bottom line through increased admissions, which translates into more funding.

Friedman's (1962) influence, along with the Coleman Report, indirectly launched a movement toward the public-private option or charter schools. Operating with public money outside of public control, charter schools vary in their required reporting from state to state, but

all share the common requirement of presenting to the LEA financial disclosures and student test scores to confirm or repudiate their claims of higher efficiency and/or efficacy.

While Nelson, Muir, and Drown (2003) and Speakman and Hassel (2005) have shown that charter schools overall receive less funding per pupil than their traditional counterparts, it is unclear what the difference is, if there is one. That calculation is skewed by factors including the exclusion of charters from the economies of scale that larger districts can utilize to mitigate costs for large volume needs, such as paper towels for restrooms or chalk for classrooms. It is not, and cannot be, a true dollar-for-dollar comparison. An area given attention in the article was that of facilities and their associated costs. The costs for facilities obviously differ across geographic locations, and within districts. For example, in a district that was losing population, a charter school often occupied a vacated or under-occupied school building (Fiske and Ladd, 2013). Conversely, in growing districts, such as Wake County, NC, facilities for charter schools were often found in former industrial or commercial spaces, and the facilities came with a more substantial price tag. The difference in funds allocated to facilities among charter schools was dramatic, and districts and states were inconsistent in regard to facilities funding on top of the per-pupil allotments.

Review of Charter School Performance

Charter schools constitute a prominent concern and as such, a relevant object for research within academics. Proving or disproving the deregulatory argument in favor of charters has been the aim of numerous studies, and the body of literature concerning charter school outcomes continues to grow. What follows are findings from a selection of influential authors and research groups.

In their study of the 2003 NAEP data, Lubienski and Lubienski (2006) argued that when student demographics are accounted for, the private school effect (specifically, higher achievement scores) is neutralized, and in many cases reversed. They acknowledge that their findings differ from the results found in Choy (1997) and Hoxby (1994, 2003). Further clarifying their position, Lubienski and Lubienski published a further analysis of their study in 2006, offering this within the executive summary:

> These notable findings regarding the remarkable performance of public schools are significant, not just statistically, but also in terms of their policy implications. The presumed panacea of private-style organizational models—the private-school advantage—is not supported by this comprehensive dataset on mathematics achievement. These data suggest significant reasons to be suspicious of claims of general failure in the public schools, and raise substantial questions regarding a basic premise of the current generation of school reforms based on mechanisms such as choice and competition drawn from the private sector.

What they refer to as "private-style educational models" was defined as including charter schools along with voucher programs, which they analyzed in depth in their 2009 article, along with P. Wetzel. wherein they attempted to refute the perceived consensus surrounding voucher programs and private education.

Countering the Lubienkis' research, Abdulkadiroğlu et al. (2011) investigated achievement gains for students in Boston's charter and pilot schools, both of which had student assignment by lottery (which limits the student demographic background effect). The authors found that middle and high school students in charters had statistically significant gains, while those in pilots had insignificant gains or even negative results. The authors proposed that the inequity between the programs was the result of structural differences in how each was staffed; pilots were subject to collective bargaining by unionized faculty, whereas charters were not. Thus, charter faculty tended to be younger, turn over more frequently, and utilize different measures of achievement than pilot faculty.

CREDO has published several reports on charter school performance. The most recent study was published in 2013, and offers a detailed consideration of the performance of charter schools nationwide. Most striking was their analysis of charter schools' performances as compared to their local markets in both reading (green) and math (pink):

Figure 2.4: Graphical Representation of Charter School Reading and Math Gains/Losses Relative to TPS Market

Source: CREDO, Executive Summary, https://credo.stanford.edu/documents/NCSS%202013%20Executive%20Summary.pdf

CREDO's results are a mixed bag for charter advocates and opponents alike. If charters are truly experimental in their curricular practices, then one could expect outcomes like this, but only if the results were aligned institutionally. However, if the lessons of what does and does not work are not being passed along to the larger, traditional public school system, then charters are, in fact, relatively average in relation to their local markets, and may be simply redundant.

Carolyn Hoxby, writing in 1994, examined the effect of school choice on student achievement and district finances. She found that greater choice of schools within districts had nearly exclusively positive effects. Specifically:

> I find evidence that easier choice leads to greater productivity. Areas with greater opportunities for choice among public schools have lower per-pupil spending, lower teacher salaries, and larger classes. The same areas have better average student performance, as measured by students' educational attainment, wages, and test scores. Performance improvements are concentrated among white non-Hispanics, males, and students who have a parent with at least a high school degree. However, student performance is not worse among Hispanics, African-Americans, females, or students who do not have a parent with a high school degree. Also, student performance improves at both ends of the educational attainment distribution and test score distribution.

Although Hoxby's analysis came before much of the charter school movement had begun, her reasoning for choice was attractive to nearly all constituents except for public school faculty and staff. Lower PPE, higher achievement, and lower salaries are all interesting and uncommonly associated factors.

Almost a decade later, Hoxby again commented upon the importance of choice. This time in an environment including charters, and reached a similar conclusion. Highlighting the importance of competition effects on all schools in a district, Hoxby (Hoxby, 2003, p. 339) argued that "schools that face choice-driven incentives can be induced to raise their productivity." She supported her argument with evidence from districts with for-profit choice schools, not-for-profit choice schools, and in districts with only TPS choice schools.

In 2014, Roland Fryer discussed translating the best instructional practices discovered in charter schools into the larger public school system in Houston, Texas. His study incorporated five techniques (increased instructional time, high-dosage tutoring, data-driven instruction, more effective teachers and administrators, and a culture of high expectations). His findings showed significant benefits of the practices for mathematics, but had insignificant effects upon reading achievement. Comparable experiments in Denver and Chicago found similar results.

Shortly after Fryer (2014) published, Clark, Gleason, Tuttle, & Silverberg (2015) posed the question: "Do Charter Schools Improve Student Achievement?" The authors utilized

achievement data from standardized test scores in 33 samples in which students were selected for charters based on a randomized lottery. Researchers compared the achievement data of students who were admitted to the data of those who were not selected through regression analysis, then evaluated school impact on achievement. Their results were not statistically significant, but trended toward a negative effect, within the expected error.

Nationally, a trend within charter school geography is that they are most commonly established in racially diverse neighborhoods, often as the deregulated answer to failing public school options. In Michigan, the average (mean, 25th and 75th percentile) test scores among first-year charter school students consistently went down each year of Bettinger's (2004) study. One posited reason is that the number of disadvantaged students entering charter schools from low-performing backgrounds increased, or that an increasing number of students transferred to a different school (many of them charters) every year. The tie between the increase in economically disadvantaged students and the increase in charter schools established in high-diversity neighborhoods is clear. And while the trend across Michigan was for second year (and beyond) charter students to improve, the transient student population had grown, making the option for charter rather than a consistent public option more suspect.

Similarly, Bifulco and Ladd (2006) found that up to 30% of the poor student performance among charter school students in North Carolina could be attributed to high rates of student turnover. Additionally, Renzulli and Evans, publishing in *Social Problems* in 2005, shared the results of their research on school choice and racial diversity. They concluded, drawing upon racial competition theory, that charter schools may have been driving a return to the "white-flight" school segregation movement of the 1960s and 1970s. One of their primary concerns was that charter schools allowed for school choice based on the perceived elevated status of the

students enrolling (a.k.a., non-minority) but without the financial costs of relocation or independent school fees. This essentially allowed charter schools to be publicly financed, racially segregated institutions allowing for a geographically diverse, but not necessarily racially diverse population.

Renzulli and Evans (2005) further asserted that the perceived value of property and status of an educational institution can be diminished in the eyes of white citizens when diversity levels in neighborhoods and schools rise. The authors found that 30% enrollment was the proverbial "tipping point" for white flight to occur in a school, and that racial segregation was greater between districts than within districts, indicating that families were willing to relocate to specific areas to find the student-body racial composition they favored. Within the context of charter schools, the initial research was encouraging through an equity/access/diversity lens: 51% of all charter enrollments in 2003 were minority students, compared to 41% in traditional public schools, indicating that the charter movement was fulfilling its promised potential to reach minority students (Frankenberg and Lee, 2003).

However, when drilling down further, variation within states can be dramatic. In California, Wells (1998) found that 37 percent of charter schools were 80%-100% white students. In Florida, Crew and Anderson (2003) found that charter schools were 30% more racially segregated than public schools, and similarly in Arizona, Cobb and Glass (1999) found that charters were 20% "more white" than traditional public schools. The state-level data refutes the narrative and the averages, showing that they appear sound on a macro level, while segregation can still, and did, occur at the micro level.

Previous Charter School Efficiency Studies

Charter schools have been studied for their efficiency in relation to traditional public schools, but researchers have not measured charter schools against each other or employed the modified quadriform.. In addition, the studies have had strikingly dissimilar conclusions about efficiency. Grosskopf (2009) asserted that Texas charters schools enjoy a statistically significant advantage in efficiency in comparison to their TPS counterparts, while Bifulco and Ladd (2006) determined that charter schools in North Carolina were significantly less efficient than their TPS "competition."

Eric Bettinger (2004) published an article in the *Economics of Education Review* concerning charter school efficiency and citing a study he had conducted in Michigan, a state that established charter schools at a higher-than-average pace. Building on the work of previous educational organization studies such as Coleman, Hoffer, and Kilgore (1982), who investigated differences in student cognitive outcomes between public and private institutions, and Evans and Schwab (1995), who refined the question to study exclusively Catholic schools, Bettinger extended the research to include charter schools.

Bettinger (2004) was building upon research already performed and published by Solmon, Park, and Garcia (2001), Nelson and Hollenbeck (2001), and Hoxby (2001) among others. In a finding consistent with that of Eberts and Hollenbeck (2002), Bettinger found that students who attended a charter school in Michigan do not enjoy an academic advantage relative to their traditional public school counterparts, and in fact their scores may decline in comparison to their public school counterparts.

In "The Relative Efficiency of Charter Schools," Shawna Grosskopf, Kathy Hayes, and Lori Taylor (2009) utilized input distance function analysis to conclude that charter schools in

Texas were significantly more efficient than their TPS counterparts. Other literature that supported charter schools as more efficient comes from CREDO (2015) citing that specifically in urban districts, students have a significant gain in instructional days relative to their TPS counterparts.

Closer to home, Robert Bifulco and Helen Ladd (2006) published a study titled, "The Impacts of Charter Schools Upon Student Achievement: Evidence from North Carolina." They reached a similar conclusion to Bettinger (2004), asserting that North Carolina charter school students do not, overall, enjoy large academic achievement gains when compared to their TPS counterparts. Further, they conclude that any overall gains that charter schools are offering to the public school system are offset by the large negative impact they have on achievement.

Overview of Funding in Charter Schools

Nationally, charter school funding mechanisms vary significantly. One relevant example outside of North Carolina is Michigan, where charter school funding is set at 97% of the state allocation for public school students. However, charters in Michigan do not receive any local supplements, nor do they have access to funds for renting or purchasing facilities. The remaining 3% of funds go to the authorizing agency to cover administrative costs. In Bettinger's (2004) study, the funding amount per student from the state was nearly $6,000 per student, meaning that the school received $5,800 per student, while the authorizing agent received roughly $200 per student. That model incentivized authorizing agents to bring in as many students as possible, especially given the dearth of local supplements or facilities funding. Also, if an authorizing agency planned to pay a non-instructional, full-time employee, only a large number of students would make that feasible, with every 100 students only accounting for $20,000 of authorizer funding.

NC Charter Schools Legislation

The legal basis for charter schools in North Carolina was established on June 21, 1996 with ratification of NCGS §115C-218. Per the statute, charter schools are established and charged as follows:

> Purpose of Charter Schools. The purpose of this Article is to authorize a system of charter schools to provide opportunities for teachers, parents, pupils, and community members to establish and maintain schools that operate independently of existing schools, as a method to accomplish all of the following:
>
> 1. Improve student learning;
> 2. Increase learning opportunities for all students, with special emphasis on expanded learning experiences for students who are identified as at risk of academic failure or academically gifted;
> 3. Encourage the use of different and innovative teaching methods;
> 4. Create new professional opportunities for teachers, including the opportunities to be responsible for the learning program at the school site;
> 5. Provide parents and students with expanded choices in the types of educational opportunities that are available within the public school system; and
> 6. Hold the schools established under this Article accountable for meeting measurable student achievement results, and provide the schools with a method to change from rule-based to performance-based accountability systems.

Further legislation, all under the NCGS §115C-218 designation, cover the totality of rules and regulations governing charter school operations, funding, and reporting.

North Carolina Charter Schools

The first charter schools in North Carolina opened their doors in the fall of 1997 (Bifulco and Ladd, 2006). Less independently governed than Michigan or Arizona (another early adopter and loose regulator), North Carolina schools followed policies that were squarely in the middle

of the regulatory spectrum. Like Michigan, no charters may be obtained by religious organizations, but unlike many other charter school adopters, there is a minimum requirement for certified teachers: 75 percent of faculty in grades K-5 and 50 percent in grades 6-12. Charters in North Carolina can be revoked for several reasons, but most notably for poor student performance and financial mismanagement. Between 1997 and 2006, seven charters were revoked, and seven more were voluntarily relinquished due to low enrollment and financial trouble. Conspicuously, since 2006 no charters have been revoked in North Carolina due to low student performance. Overall, roughly 12% of all charters opened in North Carolina after 1997 were closed by 2006. (Bifulco and Ladd, 2006)

Unlike Michigan, North Carolina charters receive a pro-rated percentage of the local supplement in addition to the per-pupil payment, and there is access to federal (but not state) education dollars to fund facilities. Additionally, in North Carolina charter schools, students are required to take the same state tests as traditional public school students. While NCGS §115C-218.105 protects the budgetary commitments of a charter school (ensuring faculty and staff are paid, programs are funded, etc.), it does present a possible equity issue. The law gives the charter school the per-pupil funding. If a student leaves a particular school any time in the first 60 days, those funds go with the student to his or her new school. However, if a student is expelled from a charter school on day 61, he or she would legally be compelled to attend a TPS (as the TPS is compelled to accept the student). However, funding for that student would remain at the charter school.

The numerous differences in funding between charters and TPS can vary from state to state (based upon the funding model employed by a particular state), but in North Carolina, the distinctions are clearly laid out. Public school administrative units may receive funding from

multiple avenues: federal, state, and local governments chief among them, and also through private allocations and fundraising organizations, such as booster clubs and PTAs, but their overall budget must be in accordance with the State Board of Education's (SBE) budget resolution for the fiscal year. Individual schools may utilize public and private funds as they acquire them, with no limitations upon their spending, as defined in NCGS §115C–425. To keep superintendents and school administrative units accountable, NCGS § 115C–427-499 covers the creation, submission, review, accounting, and reporting of all budgets, funds, loans, bonds, and scholarships payable to or through the administrative unit.

Charter schools receive public funds per NCGS §115C–238.29H, which requires that charter schools receive "an amount equal to the average per pupil allocation for average daily membership from the local school administrative unit allotments…" and the LEA sending the student is required to share allotments from the local current expense fund. To keep charter schools accountable there is a private board, not responsible to the local school administrative unit (NCGS §115C–238.29E). Charter schools are also required by the same statute to maintain federal tax-exempt status, and adhere to 501 c3 regulations of a non-profit organization. Additionally, charter schools are subject to an annual financial audit pursuant to standards established by the SBE, mainly based on the School Budget and Fiscal Control Act, NCGS §115C–422-452. For context, per the NCES, in 2012-2013 the average PPE for a N.C. charter school was $4,957.10, with a median value of $4,738.50. For traditional public schools, the average PPE was $5,484.57, with a median value of $5,331.

Table 2.1: Mean and Median PPE in North Carolina TPS and Charter Schools 2012-2013

School Type	Average PPE	Median PPE
Traditional Public School	$5,484.57	$5,331.00
Charter School	$4,957.10	$4,738.50
Difference	$527.47	$592.50

Framework for Interpretation

Springer, Houck, and Guthrie collaborated for the opening chapter in *Handbook of Research in Education Finance and Policy* (Ladd & Fiske, 2013) and addressed the "History and Scholarship Regarding United States Education Finance and Policy," which served as a convenient framework for this literature review. The chapter is a collection of salient policies and interventions utilized by scholars and schools over the past century to address, measure, and/or improve efficiency of resource allocation in schools.

The authors established a set of three modern public values of education finance policy (including Cubberley's efficiency) namely equity, efficiency, and liberty. Guthrie and Wong (Ladd & Fiske, 2013) highlighted the tension created between these three key social values. Each value exists in tension with the other two, but also contains its own separate line of inquiry.

Okun (1975) isolated two of the three primary social values established by Springer, Houck, and Guthrie, winnowing his argument down to equity vs. efficiency, a timely comparison for the present day as the charter school movement champions liberty and efficiency as co-values, and often treats the two as one and the same. Okun argued that if the two values (liberty and efficiency) are held as equally valid, then inefficiency must be tolerated in balance with increases in equity and vice versa. However, when the current social momentum is toward

efficiency (Hess & Osberg, 2010), then Okun argues an economist, who is only concerned with efficiency, will allow a market to function without (equal) regard to efficiency. He cited the oil embargo and subsequent cartelization of the oil industry as a relevant example. Concluding that the final balance must be measured in degrees of tradeoff, Okun (1975) asserted that efficiency and equity cannot be held in balance. Politics will always swing the pendulum to one value over the other, and often back again with some degree of frequency.

Cubberley (1906, p. 3) noted in his work *School Funds and their Apportionment,* "However desirable and even necessary it may be to provide more money with which to maintain the schools of a state, a still more important question is how to distribute this money to secure the best results." From the beginning, efficiency was at the heart of school finance study and policy creation. From Cubberley's assertion that efficiency was essential to the study of school finance, an entire industry, catalogue, and professional association has sprung forth. Springer, Houck, and Guthrie (2008) compiled and condensed the highlights of that process in their work.

The primary reasons for the increase in education funding are the rise in school expectations, legislation mandating assessment and accountability, social and community roles of the school, and the inclusion of previously excluded students with learning and/or physical disabilities. Along with the uptick in spending on education and rising expectations, the necessity of education "for societal and individual well-being" (Springer et al., 2008) has become firmly entrenched in the American psyche. A secondary, but still significant, result is that education remains one of the few industries that has not decreased its labor force in the modern era, but has increased it in both number and quality (based upon training). Since 1970, the percentage of teachers with master degrees has increased from 23.1 to 56 percent as of 2005,

and the median years in the profession has increased from 11 to 14 (Springer et al., 2008). Picus, Goertz, and Odden (2003) asserted that efficiency experienced a renaissance as a core value in education finance during the 1990s when the focus on equity was dialed up significantly (perhaps to address the zero-sum nature of the three core social values mentioned by Guthrie and Wong). They determined that meaningful institutional change is most likely to come from seeking efficiency within the instructional budget despite the challenges inherent in allowing for local administrators to maintain control of instructional direction.

Efficiency Measurement Techniques in Education

Three major techniques have been established to study efficiency in public schools. An evaluation of previous research indicates that studies can be grouped as follows: production functions, cost-effectiveness or cost-benefit studies (Hickrod, 1989). These studies employed economic principles established by for-profit entities who rely upon consumer purchasing for revenue. Conversely, schools receive the bulk of their funding from governmental authorities via taxation. Consequently, school districts face a different economic existence than private corporations or even their private school counterparts. These differences notwithstanding, educational researchers have been consistent in their efforts to improve schools through traditional economic analysis, often with varied results (Rolle, 2003).

The production function method is the oldest approach to measuring school efficiency (Hickrod, 1989). This method identifies an educational output and compares it to an independent variable. Usually there two independent variables, one that is unalterable by the administration and one that is alterable. Often unalterable factors are related to ethnicity or socio-economic status. This division of variables is carried over into the approach of the modified quadriform.

When applied to educational research, the production function method has been shown to have limitations. Sometimes the division between variables is not straightforward. For example, a central piece of the investigation is to discover the effect that dollars spent (usually PPE) have on academic output(s). This question is prominent within the literature, especially as it relates to legal challenges to the school finance system. Unhappily, spending is so meshed with socio-economic variables that several researchers (most notably Hickrod, 1989) believe there is no direct means to answer the question, "What is the effect of dollars spent in education?" It would be easier to answer if there were more schools populated with students from families with high and low expenditures and more schools with students from families with low SES and high expenditures. That is not a common scenario. Most wealthy districts around the country have high PPE and most low-income districts have low PPE.

In addition to the limitations within production function research, many previous studies were narrowly modeled. In education finance research, most results are both curvilinear and interactive, but it is difficult to find studies in the literature that were researched to where true curvilinear relations of variables employed were found (Hickrod, 1989). Many researchers accept a linear trajectory without investigating whether curves are there or not. In addition, educational variables are frequently interactive. Infrequently, researchers examine one interaction, but do not go deeper to consider other interactions. The literature shows numerous studies that are linear and additive and not curvilinear and multiplicative (Hickrod, 1989). In the earliest production function research studies, a tendency existed to search for a function that would illuminate all learning for all students, but recently research has begun to be more specific. Variables have expanded to include schools, individual programs, and sometimes, individual students.

The production function method is an input vs. output approach to efficiency measurement. Although the model has some limitations, it is not entirely without merit. The existence of educational administrators is due to the assumption that production function exists within education (Monk & Underwood, 1990). Administrators are proficient in scrutinizing the effects of expenditures upon educational outcomes, and over the past 30 plus years, production function methods have been developed that are more sophisticated than ever.

The cost-effectiveness method is a better tool for administrators who are trying to measure school efficiency. Through this method, the researcher can construct a production function equation that will predict test scores, after which a cost equation is established to predict costs. Then, the cost coefficients are compared to the production coefficients. Researchers can also run greater school effectiveness studies by establishing which educational treatment is most effective by controlling for variables related to the price of all possible educational treatments. This approach is effective, but lacks many examples in the literature.

Hickrod (1989) asserted that the lack of cost-effectiveness studies is due to the lack of a distinction between educational effectiveness and educational efficiency. The results of many cost-effectiveness studies show that a treatment may be more professionally effective, but a different treatment might be more economically efficient. Cost-effectiveness studies also often have narrowly defined outputs. To best examine efficiency, measures need to be developed that offer an inclusive output, taking many factors into consideration. Often, in education a linear relationship exists between cost and effectiveness, and in these instances, cost-effectiveness studies are ineffective. A helpful characteristic of cost-effectiveness studies is that they can answer large-scale questions in terms of accountability.

Cost-benefit analyses are based on the return-on-investment economic concept. They are focused on the economic factors of education instead of specific school finance issues. These studies are often used by state and national legislators to defend allocations of public funds. This research is frequently performed by professional economists who are not necessarily interested in educational improvements. If the United States education system was centralized—as it is in many developed countries—this approach would hold greater merit, but the U.S. school system is highly decentralized. If a rate of return on the financial investment in education was established, there would be no national (central) source of funds. Unsurprisingly, this approach is even more problematic at the state and local levels.

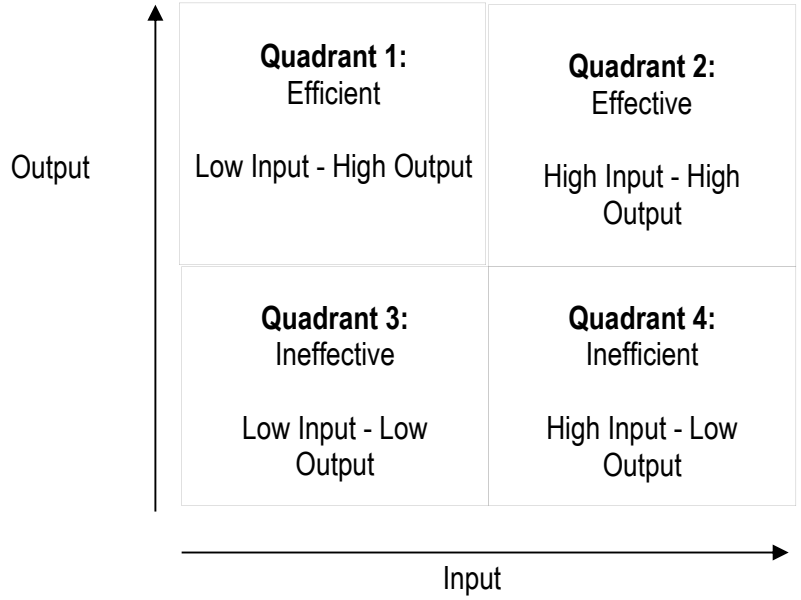
Modified Quadriform Analysis

In 2004, Anthony Rolle and Eric Houck wrote about the direction of education efficiency research. In their analysis of 21st century realities facing local administrative units and state legislatures, the authors concluded that education finance researchers must address important principles and equip the authorities with real-world solutions to solve their problems (Rolle & Houck, 2004). There is a clear need for a means of evaluating expenditures in a real-world context and with readily applicable data that can inform local, state, and national discussions. The understanding of educational efficiency, and how it can be best achieved, improved, and maintained is more pressing than ever, from the perspectives of both policy and practicality.

Just as the ideas of efficiency as a core value have evolved, so have the means of evaluating efficiency. In the 80s and 90s, production functions were popularized, but widely panned by jurists as the information was presented in legal proceedings (Hickrod, 1994). The works of Cubberley, Coleman, Okun, and others were foundational, but incomplete as education evolved to include computers and other technologies that were more expensive than paper and

pens, and more difficult to quantify. The resulting gap in efficiency evaluation tools is the space that Hickrod (1989, 1994) attempted to fill with the introduction of the quadriform, which was successfully applied, utilized, and subsequently advanced by Anderson (1996), Rolle (2004), Rolle, Houck, and He (2010) and others.The modified quadriform, begun with Anderson, allows for a direct comparison of the relative efficiency of LEAs or other units based on the form of the actual quadriform. There are four quadrants that all entities can be placed within, representing their relative efficiency (efficient, effective, ineffective, inefficient). These measures are based on the residual value of several multiple regression analyses utilizing descriptive statistics that are unalterable characteristics of each unit (income, population, etc.). Hickrod based the form on a heraldic shield, and the form allows for a familiar XY axis presentation (as seen in Figure 2.3).

Figure 2.5: The Modified Quadriform with Quadrant Definitions



Source: Houck, E. A., Rolle, R. A., & He, J. (2010). Examining school district efficiency in Georgia. Journal of Education Finance, 35(4), 331+. Retrieved from http://go.galegroup.com.libproxy.lib.unc.edu/ps/i.do?p=LT&sw=w&u=unc_main&v=2.1&it=r&id=GALE%7CA227011562&sid=summon&asid=f17bd52c5b63b3ade87dcb09c7a1a9c1

The correlation between achievement and district spending (charter school spending in this study) is called educational production function research. Regression analysis is used to compare (again, in this case) per pupil spending to student achievement while controlling for unalterable characteristics, such as demographics. Modified quadriform analysis offers an operational definition of relative efficiency that can measure the connection between resources and student achievement (Anderson, 1996).

The original quadriform was devised to allow two-dimensional relationships to be viewed graphically (Hickrod, 1989). Most often, academic output is plotted on the vertical axis and financial input is plotted along the horizontal axis. The modified quadriform differs from average-marginal cost analyses because it examines input and output variables relative to the other schools (or in other studies, school districts) in the sample. Based on the deviation from their expected error, schools are grouped into the four quadrants or an area within the heraldic shield known as the "hold-harmless" area that removes the school from final analysis. Efficient schools have high outcomes and low input; effective schools have high outcomes with high input; ineffective schools have low outcomes and low input; and inefficient schools are characterized by low outcomes with high input. Anderson first employed the modified quadriform to analyze input-output relationships quantitatively and examine diverse levels of economic efficiency among school districts (1996).

The modified quadriform model of analysis is completed by means of two multiple regression analyses to develop each axis of the quadriform, and the regression residuals (error values) are what determine into which quadrant the school will land. (Rolle, 2004). Following the regression analyses, the researcher is likely to employ discriminant analysis to establish

alterable characteristics that differentiate efficient schools from inefficient schools, and thereby offer insight into school reform (Stevens, 2006).

Conclusion

The modified quadriform is an elegant solution to the problem of assessing relative efficiency within charter schools, and offers the additional benefit of facilitating a secondary, discriminatory analysis that allows for the direct transfer of practices and policies from relatively efficient charter schools to other charter schools as well as traditional public schools, per the mission and goals of the N.C. General Assembly. Given the mission of charter schools to be efficient, innovative, and beneficial to the larger public school system, a means for evaluating the relative efficiency within charter schools was appealing and timely.

CHAPTER 3: DATA AND METHODS

Purpose of the Study

The purpose of this study was to explore charter schools in North Carolina from the perspective of relative economic efficiency. The study sought to analyze academic outcomes in the context of economic inputs to determine charter school efficiency as a baseline for further analysis. To determine efficiency, the modified quadriform was applied to the error results of a multivariable statistical analysis, and to establish quadrants of relative efficiency among charter schools in North Carolina. This study was a proof of concept as the modified quadriform has never been used to exclusively analyze charter schools. After a baseline of relative efficiency was established, the schools within each quadrant were analyzed to determine which alterable characteristics may have affected academic outputs. The study also sought to establish a model for further investigation of charter schools using the modified quadriform.

The intent of this study was not to compare disparate school organization/structural models, but to thoroughly examine the model that utilizes public money with the least oversight: charter schools. For the purposes of this study, academic achievement was the dependent variable, and for lack of a more ubiquitous alternative, that was defined as the performance composite of the North Carolina Accountability Program, or ABCs.

Theoretical and Conceptual Framework

Conceptual

Springer, Houck, and Guthrie in *Handbook of Research in Education Finance and Policy* (Ladd, Fiske, 2013) established a set of three modern public values of education finance policy (including Cubberley's efficiency) namely equity, efficiency, and liberty. Guthrie and Wong (Ladd, Fiske, 2013) highlight the tension created between the three key social values. While the pursuit of any of the three by itself is worthwhile, it also may impede the ability of the remaining two to be realized effectively. Each value exists in tension, but also contains its own, separate line of inquiry. Guthrie and Wong (2013) offer the pursuit of equity as a high value, especially as it pertains to schools, but if it becomes the primary end goal, it may severely restrict liberty and equality, diminishing the overall product in the pursuit of one component. This study sought to examine the value of efficiency and its associated line of inquiry, as it pertains to charter schools in North Carolina.

Theoretical

Schools are complex and distinct institutions, and not all hold the same primary and secondary values/goals within communities, and especially across communities and states, making a standard measure difficult at best. However, that has not deterred researchers from endeavoring to measure and compare them. Previous efficiency research has focused on the input-output relationship, and determined technical efficiency, based on units of production (Hanushek 1997, 2007; Bifulco, 2001). This study focuses instead on relative efficiency through the implementation of the modified quadriform. The modified quadriform assesses the efficiency of schools relative to one another.

Houck, Rolle, and He (2010) specified the advantages of the modified quadriform as follows:

> A quadriform is an abstract tool devised to allow relative relationships between inputs and outputs to be viewed both graphically and quantitatively. By comparing residuals of input and output oriented regression equations, the quadriform contextualizes performance into a relative rather than an absolute framework.

The main strengths of the modified quadriform are: 1) simple presentation of the data graphically, and 2) the ease with which it can be translated into educational reforms. The modified quadriform allows for the interpretation of schools as they are—highly contextualized entities. Interpreting schools in the context of relative efficiency allows for secondary, discriminatory analysis of alterable characteristics. After the alterable characteristics of relatively efficient schools have been determined, it opens the door for collaboration, implementation, and a rethinking of best practices across institutions.

The major weakness of the modified quadriform is the variability of the hold-harmless space (the heraldic cross on the shield) which can vary from study to study. While allowing the researcher to choose the right size (measured in percentages of standard deviations), it does not necessarily allow for the same kind of apples-to-apples comparison that other efficiency measures do without statistical operations being performed on the data.

Figure 3.1: The Modified Quadriform

Efficient	Effective
Ineffective	Inefficient

Research Questions

The primary research questions of this study are:

1) Can the modified quadriform be used to evaluate the relative efficiency of charter schools? (A positive outcome would be measured by high Adj-r^2 values and similar quadrant distributions as other studies.)

2) How economically efficient are charter schools in North Carolina in terms of financial inputs vs. academic outputs?

3) What alterable characteristics contribute to the relative efficiency/inefficiency of charter schools in the state of North Carolina?

4) Is the modified quadriform analysis a potentially beneficial means of evaluating charter school efficiency?

Hypothesis

The modified quadriform will be used to identify the most efficient charter schools in North Carolina. The study will then employ a discriminatory analysis of descriptive statistics to compare the most efficient charter schools to other relatively inefficient charter schools in the sample population. Are there specific characteristics associated with higher performing or more efficient schools? The primary hypotheses of the study is that relatively efficient schools will have: 1) fewer high-poverty students (Houck, Rolle, and He, 2009); 2) more guidance counselors; 3) a lower teacher-to-pupil ratio (Stevens, 2006); and 4) a higher community wealth rating than relatively inefficient schools (Houck, Rolle, and He, 2009).

National studies found a wide range of charter school performance, mediated by factors such as race and SES. I hypothesized that schools with lower racial diversity and high SES would be associated with greater efficiency, and would show sensitivity to these variables similar to traditional public schools (Alexander et. al, 1994; Bali & Alvarez, 2004). I also believed most of the 98 charter schools studied would be inefficient or ineffective. Many of these charter

schools are relatively new entities and there is a learning curve for all constituents before optimal efficiency is reached. In the interest of full disclosure, the author did wield some influence on the numbers (based upon the size of the "hold-harmless" area selected, which will be discussed in chapters 3 and 4 in detail), but he endeavored to follow best-practices established by previous study authors: Hickrod (1989,1994), Anderson (1996), Rolle (2004), Rolle, Houck, and He (2010) and others.

Design of the Study

This study was a proof-of-concept study utilizing one year of data for N.C. charter schools and one year of the N.C. ABCs composite performance score to populate a modified quadriform using multiple regression analysis. The proof-of-concept element is that no one has ever applied the modified quadriform to charter schools before, and the differences in data available require some changes in the unalterable characteristics assessed by this study. A proof of concept would be measured by high Adj-r^2 values and similar quadrant distributions as other studies.

As a proof-of-concept study, the aim of the design is to establish the utility of the modified quadriform in evaluating charter schools, and to see if it yields results similar to those in public schools. The experimental design is a derivative of the generic study design with a couple of modifications, including one extra step of plotting the results to facilitate interpretation (see Figure 3.2).

Figure 3.2: Experimental Design

Ongoing operation (charter school) ⇒X (multiple regression analysis) ⇒Y (plot results on modified quadriform) ⇒ O (relative efficiency categorization)

The modified quadriform created the lens for analysis, and while there was no specific treatment utilized or evaluated, the discriminatory analysis of the alterable characteristics created an evaluation of any number of potential treatments, or as they are called, alterable characteristics of relatively efficient schools (Campbell and Stanley, 1963).The examination of alterable characteristics in the second stage, the discriminatory analysis, allowed for the identification of any potential rival causal factors, and their subsequent examination, isolation, and further investigation. The most common problem was that a generic study does not apply to the modified quadriform itself because there is no treatment being applied. This is an assessment of schools as they are, with the understanding that each likely uses a different combination of treatments that would be further evaluated after the schools were categorized.

Control for Statistical and/or Rival Hypothesis

The modified quadriform acted as a control for rival hypotheses and statistical variance. As this study is a proof of concept effort, significant attention was paid to create high adjusted R^2 values to establish a model for charter school evaluation. The R^2 is the measure of explained variance within the study, and the higher the R^2 value, the more reliable the results of the regression (Stockburger, n.d.). A high adjusted R^2 value affords a relatively stable analysis of schools' alterable characteristics (Anderson, 1996). Rival hypotheses will be examined in the discriminatory analysis of unalterable and alterable characteristics as each are regressed against one another to determine which influence relative efficiency.

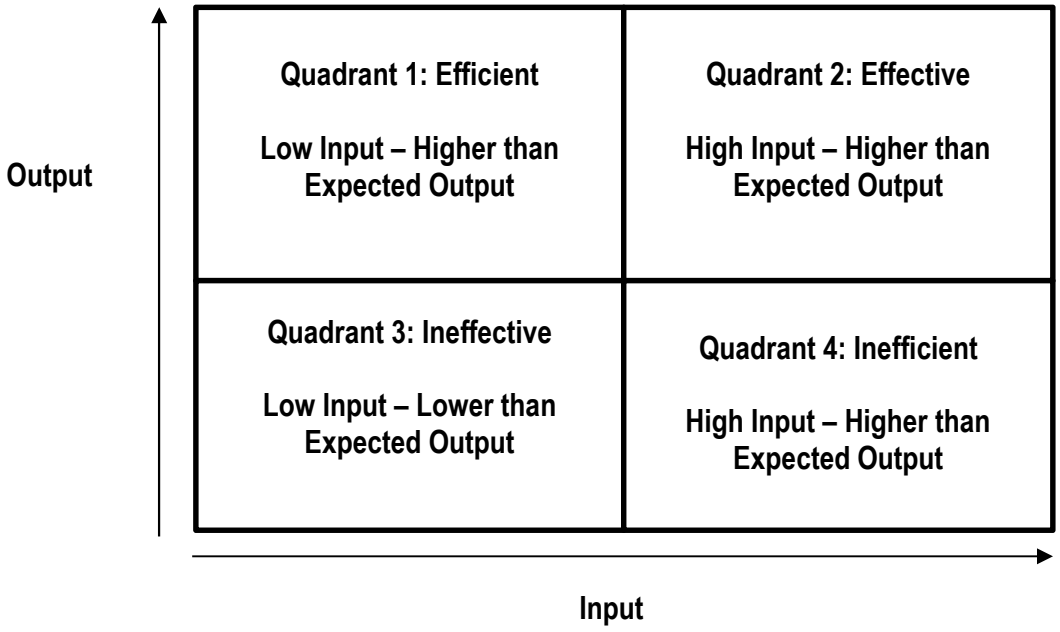
Statistical and Analytical Procedure: The Modified Quadriform

Writing in 2004, Rolle and Houck discuss possible future directions of education efficiency research. In their analysis of 21st century realities facing local administrative units and state legislatures the authors conclude that education finance researchers must equip the

authorities with real-world solutions that are based in practice and address important principles (Rolle & Houck, 2004). There is a clear need for a means of evaluating expenditures in a real-world context, and with readily applicable data that can inform local, state, and national discussions. The understanding of educational efficiency, and how it can be best achieved, improved, and maintained is more pressing than ever, from the perspectives of both policy and practicality.

Even as the ideas of what efficiency as a core value should represent, the means of evaluating efficiency have evolved. In the 80s and 90s, production functions were popularized, but widely panned by jurists as they information was presented in legal proceedings. (Hickrod, 1994) The works of Cubberley, Coleman, Okun, and others remain foundational, but were incomplete as education evolved to include computers and other technologies that were more expensive than paper and pens, and more difficult to quantify. The resulting gap in efficiency evaluation tools is the space that Hickrod (1989, 1994) attempts to fill with the introduction of the quadriform, which is successfully applied, utilized, and subsequently furthered by Anderson (1996), Rolle (2004), Rolle, Houck, and He (2010) and others.

Figure 3.3: The Modified Quadriform with Quadrant Definitions



Source: Houck, E. A., Rolle, R. A., & He, J. (2010). Examining school district efficiency in Georgia. Journal of Education Finance, 35(4), 331+. Retrieved from http://go.galegroup.com.libproxy.lib.unc.edu/ps/i.do?p=LT&sw=w&u=unc_main&v=2.1&it=r&id=GALE%7CA227011562&sid=summon&asid=f17bd52c5b63b3ade87dcb09c7a1a9c1

The correlation between achievement and district spending (charter school spending in this study) is called educational production function research. Regression analysis is used to compare (again, in this case) per pupil spending to student achievement while controlling for unalterable characteristics, such as demographics. Modified quadriform analysis offers an operational definition of relative efficiency that can measure the connection between resources and student achievement (Anderson, 1996; Stevens, 2006).

The original quadriform was devised to allow two-dimensional relationships to be viewed graphically (Hickrod, 1989). The modified quadriform, beginning with Anderson in 1996, allows for a direct comparison of the relative efficiency of LEAs or other units based on the

quadriform (four quadrants that all entities can be placed within, representing their relative efficiency [efficient, effective, ineffective, inefficient] based upon the residual value of several multiple regressions analyses utilizing descriptive statistics that are unalterable characteristics of each unit [income, population, etc.]) which Hickrod based upon a Heraldic Shield, and also has a similar view to an XY axis presentation, though with intentional negative space.

Most often, academic output is plotted on the vertical axis and financial input is plotted along the horizontal axis. The modified quadriform differs from average-marginal cost analyses because it examines input and output variables relative to the other schools (or in other studies, school districts) in the sample. Based upon the deviation from their expected error, schools are grouped into four quadrants: efficient, effective, ineffective and inefficient, with an area within the heraldic cross known as the "hold-harmless" area that removes the school from final analysis. Efficient schools have high outcomes and low input; effective schools have high outcomes with high input; ineffective schools have low outcomes and low input, and inefficient schools are characterized by low outcomes with high input. Anderson (1996) first employed the modified quadriform to analyze input-output relationships quantitatively and examine diverse levels of economic efficiency among school districts.

The modified quadriform model of analysis is completed by means of two multiple regression analyses to develop each axis of the quadriform, and the regression residuals (error values) are what determine in which quadrant the school will land (Rolle, 2004). Following the regression analyses, the researcher is likely to employ discriminant analysis to establish alterable characteristics that differentiate efficient schools from inefficient schools, and thereby offer insight into school reform.

Procedures

Schools are highly contextualized. Objective measures of their efficiency—such as those developed for profit-seeking entities—are less effective and/or applicable to reform. In this study, efficient schools will be those schools that achieve higher-than-expected academic output while using lower-than-expected PPE. The modified quadriform provides a method to analyze the input-output relationship in the context of education, to understand relative efficiency.

A successful modified quadriform requires two stages of analysis. Stage one is the linear regression analysis. The input regression is total PPE for the school regressed against the unalterable characteristics of the school. Consequently, the dependent variable is total PPE, and the independent variables are the characteristics that cannot be changed by school personnel. In this study, the unalterable characteristics are: Per-pupil expenditures, student demographics including gender, ethnicity, and socio-economic factors (including percentage of free and reduced-price lunch and county wealth) as well as ELL student percentages and Individualized Education Plan (IEP) student percentages. In the output regression, student achievement is regressed against the same unalterable school characteristics. As in the first regression, student achievement is the dependent variable, and the unalterable characteristics are the independent variables. The measure of student achievement utilized is the composite performance score of the N.C. ABCs.

Employing the modified quadriform model, Equation 1 can be explained this way:

$$Y= \beta_0X_0+\beta_1X_1+\beta_2X_2+\varepsilon$$

Y is the expected value for each school, either total PPE or ABCs composite performance score. The X variables represent unalterable characteristics of each school. The ε represents the residual (or error) value for each school. The residual (error) value is the difference between the actual

PPE or composite performance score and the value predicted by the two regressions. After residual (error) values are found, each school will be placed per that value, onto a XY axis of input/output, and the heraldic cross will be laid over it, leaving each school in one of four quadrants (Q1-Q4) or the hold-harmless area. Q1 contains schools that achieve high outcomes with low PPE. Q2 contains schools with low outcomes and high PPE. Q3 contains schools with high outcomes and high PPE. Q4 contains schools with low outcomes and low PPE.

Stage two is a discriminant analysis to identify alterable school characteristics in relatively efficient schools. Alterable characteristics include anything that a school administrator would likely have direct influence over within his or her school, such as: teacher-to-pupil ratio, the number of guidance counselors in the school, and the number of administrators. As the inputs and outputs are contained in two distinct regressions, the unalterable characteristics may be compared to total PPE and academic output individually. Next, alterable school characteristics that can be changed are analyzed since all unalterable characteristics have been removed. The isolation of the alterable characteristics is what separates the modified quadriform from other efficiency measures. Variance is eliminated owing to the unalterable characteristics, which affords a relatively stable analysis of schools' alterable characteristics (Anderson, 1996; Stevens, 2006).

Data Selection: Criteria and Process

The per pupil expenditure, gender, ethnic, ELL, free and reduced-price lunch, and IEP student data for this study come from the National Center for Education Statistics (NCES) database for the 2012-2013 school year. The county wealth and effort (tax) measures come from the North Carolina Public School Forum Local School Finance Study from 2013. Both the NCES and The N.C. Public School Forum are academically reputable, and have been utilized

and cited in many academic papers, studies, and presentations (Herzog & Pittman, 1995; Almeida, 2004; and Reeves, 2003).

When selecting variables, the distinction between alterable and unalterable is important, but the primary concern is gathering the proper variables to create a high adjusted r^2 value and establish a model for charter school evaluation. The criteria for the data selection was as follows: publicly available, objective, from a government source if possible, and if not, from a reliable source such as the "2013 Local School Finance Study," compiled and published by the nonpartisan North Carolina Public School Forum.

The data for this study is broken down in Figures 3.4 and 3.5 by total population mode, median, and mean. Figure 3.4 contains community and school employee data, and is a mixture of alterable and unalterable characteristics. The ABC Composite is the performance score for all students in the school on the North Carolina battery of standardized tests; this offers statistical evidence of a school's academic output. The composite performance index is an alterable variable, as academic performance can be changed over time, and through the direct effort of administrators. FRPL is the average percentage of students that qualify for free and reduced price lunch in the county where the charter school is located; it is a proxy of the community context for the school itself. The county wealth index is a measure calculated annually by the Public School Forum of North Carolina and is a measure of the county's ability to fund public education relative to the state average. The county effort index, also produced by the Public School Forum of North Carolina, represents the effective tax rates to fund education within each county relative to the state average. These measures contextualize the local supplement given to education (of which the charter gets a percentage) as well as the relative level of community wealth, and are unalterable characteristics.

The PPE is found by taking the total expenditures of a school and dividing by the total number of students. PPE is a basic unit of financial input against which the other variables can be regressed. FTE (full-time equivalent teachers), admins (administrators), and counselors are the number of full-time members of each employee category employed by each school, as reported by the NCES. The measure of students per teacher, or the per-pupil ratio, is found by dividing total number of students by total FTE. All of the staff positions, as well as the ratio of staff to students, are alterable characteristics and may have an impact on relative efficiency.

In Figure 3.5, student demographics are broken down by their descriptive statistics. Each category in the figure is an unalterable characteristic and will be utilized in the regression analysis. All of the categories were produced with information from the NCES.

Table 3.1: Descriptive Statistics of Variables Regressed

	ABC	FRPL %	County Wealth Index	County Effort Index	PPE	FTE	Admins	Counselors	Pupils Per Teacher
Mode	100	34.82	1.45	0.25	8101	15	0	0	#N/A
Median	80.6	57.12	0.91	0.26	8132	24.93	0	0.05	14.43
Mean	84.4	57.39	1.09	0.28	8761.94	31.45	0.29	0.73	15.02
STD Dev.	15.56	13.42	0.48	0.07	2322.18	22.62	0.5	1.01	3.58
#Observ	98	98	98	98	98	98	98	98	98

Table 3.2: Descriptive Statistics of Variables Regressed

	Male	Female	Hispanic	Black	White	2 + Races	Asian/ Pacific Islander	Lep / ELL	IEP
Mode	100	34.82	1.45	0.25	8101	15	0	0	#N/A
Median	80.6	57.12	0.91	0.26	8132	24.93	0	0.05	14.43
Mean	84.4	57.39	1.09	0.28	8761.94	31.45	0.299	0.73	15.02
STD Dev.	15.56	13.42	0.48	0.07	2322.18	22.62	0.5	1.01	3.58
#Observ	98	98	98	98	98	98	98	98	98

Source: NCES, ELSI Table Generator. 2012-2013 School District (LEA) Characteristics. www.nces.ed.gov

Conclusion

The modified quadriform is the product of a multiple regressions analysis, and allows for a graphical representation of relative efficiency. It also creates an opportunity for secondary,

discriminatory analysis, which offers the prospect of easy transferability of programs and policies between schools. It is a methodology that was adapted from Hickrod (1989) by Anderson (1996), and it has been applied to numerous other samples. Rolle (2004) calls it one of the essential methodologies that modern education finance researchers should utilize.

The variables selected for this study were chosen based on reliability, availability, and relevance to the research question with the goal of creating an initial, proof of concept study with a high adjusted R^2 value. The variables represented unalterable and alterable characteristics of North Carolina charter schools and allowed for the modified quadriform's two-stage analysis to occur. The experimental design required multiple regression analyses and data points based on error residuals to be plotted on an xy axis. The axes represented input and output, and the modified quadriform was laid over it as a lens for interpretation and further analysis. Hypotheses were that relatively efficient schools would be in line with results from previous studies, and would be characterized by: 1) fewer high-poverty students (Houck, Rolle, and He, 2009); 2) more guidance counselors; 3) a lower teacher-to-pupil ratio (Stevens, 2006); and 4) a higher community wealth rating than relatively inefficient schools (Houck, Rolle, and He, 2009).

CHAPTER 4: FINDINGS AND ANALYSIS

Introduction

This chapter will follow the steps taken to complete the modified quadriform analysis, and will present findings which will be discussed in detail in Chapter 5. The data is broken down in various ways and represented graphically through tables and figures.

Obtaining Input and Output Residuals

To answer the first and second research questions, school data must be graphed into a scatterplot for the quadriform to be applied. As suggested in the literature, one of the most important parts of MQF analysis is finding the correct model for equations that predict resources and performance. The limited data on charter schools in North Carolina presented a challenge that required a change in the model from previous studies, namely that the independent variable for input regression was changed from PPE to pupil-to-teacher ratio (PTRat).

As discussed in Chapter 3, PPE was regressed against the county average of FRPL, the NCPSF county wealth index, the North Carolina Public School Forum county effort index, the percentage of students that is Asian or Pacific Islander, Hispanic, Female, Black, have an IEP, and who are ELL, as well as the number of full-time equivalent teachers and guidance counselors, and finally weighted by school enrollment. In addition, a variable was created, "wealth x effort" which is an interaction term, and was found by multiplying the NCPSF wealth number by the NCPSF effort number, resulting in a measure that effectively highlights districts that have both high wealth and high effort. As demonstrated in Table 4.1, the initial regression

models resulted in lower-than-expected adjusted R-Squared values, averaging 0.331 (see Table 4.1). Adjusted R-Squared values increased dramatically, to .794, when the resource variable, pupil teacher ratio was substituted for the dependent variable (see Table 4.1).

While it is a departure from previous studies, it is legitimate to use a resource allocation framework (PTRat) rather than an expenditure framework (PPE) because it is commonly agreed upon that the most valuable resource in a school is the teacher (Kirst, 1983; Hanushek, 1986; Rolle, 2004). In North Carolina, the school finance formula is based on student-to-teacher ratios, e.g. 21 students per teacher (NC DPI Allotment Data, 2016). Since the N.C. system is based on these ratios, it seems rational to analyze charter schools through the PTRAT model. Even though the funding system is not precisely the same for charter schools, that is the statewide context. The charter system assigns a dollar amount per student, leaving the ratio decision in the hands of the individual charter, making the association even more interesting.

Table 4.1: Models used for predicting resources in NC charter schools

Model	(1) PPE	(2) PPE	(3) PTRat	(4) PTRat	(5) PTRat	(6) PTRat	(7) PTRat
Dependent Variable	FRPL	FRPL	FRPL	FRPL	FRPL	FRPL	FRPL
Wealth	X	X	X	X	X	X	X
Effort	X	X	X	X	X	X	X
Gender	X (F)	X (F)	X (F)	X (F)	X (F)	X (F)	X (F)
Hispanic	X	X	X	X	X	X	X
Asian/Pac Islander				X	X	X	X
African American	X	X	X	X	X	X	X
White	X	X	X		X	X	X
ELL	X	X	X	X	X	X	X
IEP	X	X	X	X	X	X	X
Teachers		X	X	X			X
Admin		X	X	X	X	X	X
Guidance		X	X	X	X	X	X
Wealth x Effort						X	X
N (weight: enrollment)	47631	47631	47631	47631	47631	47631	47631
F	2613.53**	2114.16**	2510.99**	2526.67**	6335.73**	11261.71**	10812.22**
AdjR^2	0.331	0.347	0.401	0.408	0.651	0.791	0.794

As can be seen in Table 4.1, the models used were varied. Of the seven models regressed, two produced adjusted R^2 values between 0.3 and 0.4, two produced values between 0.4 and 0.5, one produced a value between 0.6 and 0.7, and two produced values between 0.7 and 0.8. The final model included all available data and produced the highest adjusted R^2 value. Increasing the value of the adjusted R^2 is important for the validity of the study because the adjusted R^2 represents the level of variance within the model, and the higher the value, the lower the variance. In other words, the adjusted R^2 moves higher if additional variables improve the model more than is expected by mere chance. Likewise, adjusted R^2 decreases when a variable does not improve the model by more than would be expected by chance.

Table 4.2: Models used for predicting performance in NC charter schools

Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Dependent variable	FRPL	FRPL	FRPL	FRPL	FRPL	FRPL
Wealth	X	X	X	X	X	X
Effort	X	X	X	X	X	X
Gender	X (M)	X (M)	X (F)	X (M)	X(M)	X(F)
Hispanic	X	X	X		X	X
Asian/Pacific Islander	X	X	X	X	X	X
African American	X		X	X	X	X
White		X			X	X
ELL	X	X	X	X	X	X
IEP	X	X	X	X	X	X
Teachers	X		X	X	X	X
Admin	X	X	X	X	X	X
Guidance	X	X	X	X	X	X
Wealth x Effort					X	X
PPE						X
N (weighted by enrollment)	47597	47597	47597	47597	47597	47597
F	3057.62**	3057.63**	2954.34**	3187.98**	5407.17**	10812.22**
AdjR2	0.435	0.431	0.447	0.446	0.659	0.794

In Table 4.2, the models used were also varied. Of the five models regressed, two produced Adj R^2 values. Four produced values between 0.4 and 0.5, one produced a value between 0.6 and 0.7, and one produced a value between 0.7 and 0.8. The final model included all available data and produced the highest Adj R^2 value.

To perform all the initial data analysis, StrataSE 14 64-bit (a statistical regression program) was used to regress the dataset, and residuals were established for both PTRat (the measure of resources, or input) and PerfComp (the measure of performance, or output). After the residuals were created, they were graphed into a scatterplot. The scatterplot can be seen in Figure 4.1.

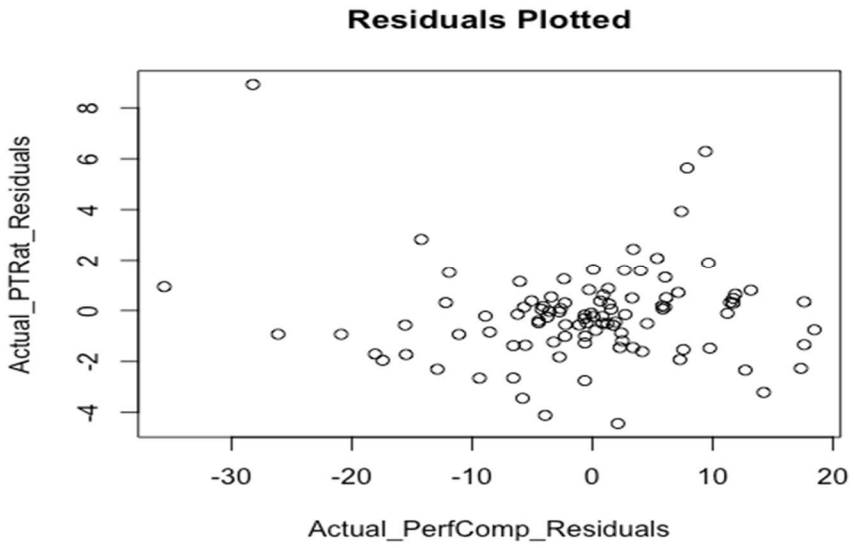
Table 4.3: Descriptive Statistics of Regression Residuals

	PerfComp (Output)	PTRat (Input)
Mean	-0.615	-0.177
Median	0.080	-0.239
Std. Dev.	9.649	1.893
N	97	97
Maximum	18.462	8.920
Minimum	-28.220	-4.437

Table 4.3 shows the descriptive statistics of the residuals. The mean is negative for both input and output, and the median is negative for the input, and only slightly positive for the output.[1] The descriptive statistics generated by the regression analysis will be used after the data has been plotted on an XY axis to determine the internal borders of the quadriform. Following the creation of the descriptive statistics, the data was placed into a scatterplot, seen in Figure 4.1.

[1] The reason there are only 97 data points is that Grandfather Academy, though included in earlier graphics of the study, was removed from the study as it lacked a performance composite score, and therefore created a residual that was the total amount predicted, and would have skewed the data

Figure 4.1: PerfComp and PTRat Residuals Plotted



The scatterplot shows a majority of the data points are concentrated near the 0/0 intersections, but with many others spread around the plot. The concentration of data points at 0/0 indicates that many of the schools studied are performing as expected.

To establish the quadrants of the modified quadriform, both the mean and the median were considered as the intersection of the lines that form the quadriform and to ensure that the best representation of the average school was established prior to expanding a hold-harmless area within the heraldic cross (Hickrod, 1989). Considering both variables, the median was chosen, consistent with previous studies (Houck, Rolle, & He, 2010). After the median was selected as the intersection of the heraldic cross, the mean values were used to plot the performance of the average charter school in North Carolina. Figure 4.2 includes the quadrant defined by the median lines.

Figure 4.2: Residuals Plotted with Quadriform Overlaid at Median Values

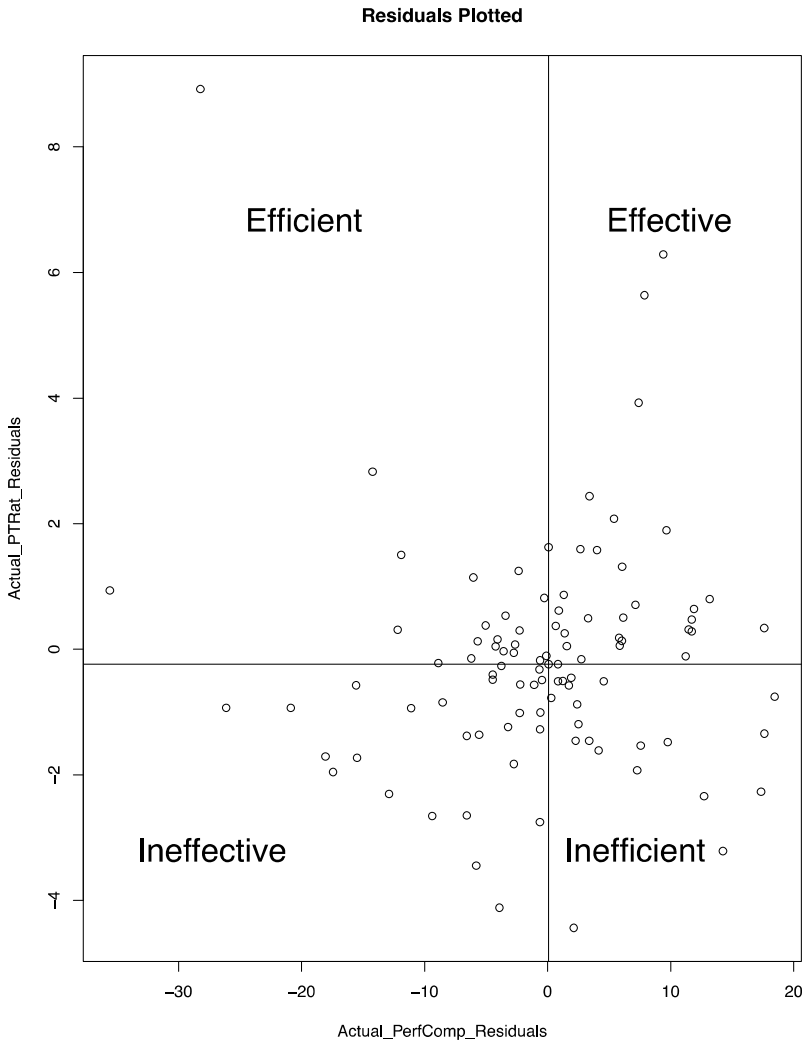


Figure 4.2 shows the quadriform laid across the scatterplot at the intersection of the median residual values. It is evident that many of the data points are near the intersection of the quadrants, and the closer data points are to the intersection, the closer the schools are to performing as expected.

Holding Schools Harmless

In Figure 4.2 are the labels of the four quadrants, established in Figure 4.2. Based on the deviation from their expected error, schools are grouped into the four quadrants (efficient,

effective, ineffective and inefficient) with an area within the heraldic cross known as the "hold-harmless" area that removes schools from final analysis. The hold-harmless area is important to the modified quadriform analysis as it excludes schools that are performing as predicted by the regression and are not representative of any quadrants. For example, the 0.5 level assumes that more variance is random and not systematic than the 0.1, and as such, the data can be subjected to a more stringent test of efficiency. By excluding results that perform as predicted by the regressions, values within each quadrant are not skewed by schools that are performing as expected and represent only the schools that are not performing as predicted.

After quadrants are established using the median input and output values, the standard deviation—or a percentage of the measure—was utilized to determine the size of the heraldic cross and the hold-harmless area that will exclude schools from the secondary analysis. Previous studies (as shown in Table 4.5) have applied only two different percentages of a standard deviation to establish the hold harmless area, either 0.1 or 0.5 of a standard deviation.

Table 4.4: Previous Study Hold-Harmless Cross Sizes

Previous Study	Standard Deviation Proportion Used for Establishing Hold-Harmless Cross
Hickrod, 1994	0.5
Anderson, 1996	0.1
Houck, Rolle, He, 2010	0.1
Rolle, 2003	0.5
Genge, 1991	0.5

For this analysis, data was analyzed utilizing a hold harmless cross set at both 0.1 and 0.5 of the standard deviation of the median value (as seen in Table 4.4). At 0.1 std. dev, the data would produce a set of 23 efficient schools for analysis, while conversely, at a level of 0.5 of a standard deviation—as used in Hickrod (1994), and Rolle (2003)—the dataset of six efficient schools, is a more conservative number for thorough secondary (discriminatory) analysis. This

study will utilize both a 0.1 standard deviation of the median and a 0.5 standard deviation of the median for the analysis, and the results can be seen in figures 4.3 and 4.4.

Figure 4.3: 0.1 Standard Deviation of the Median Quadriform

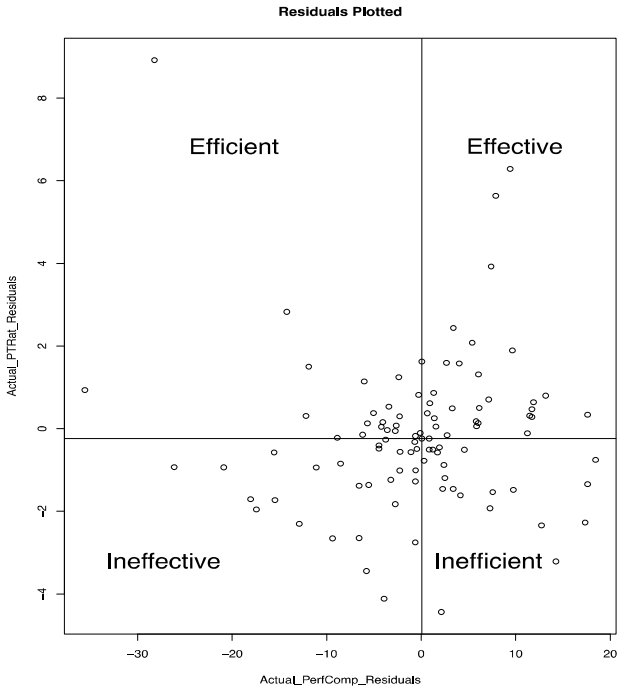
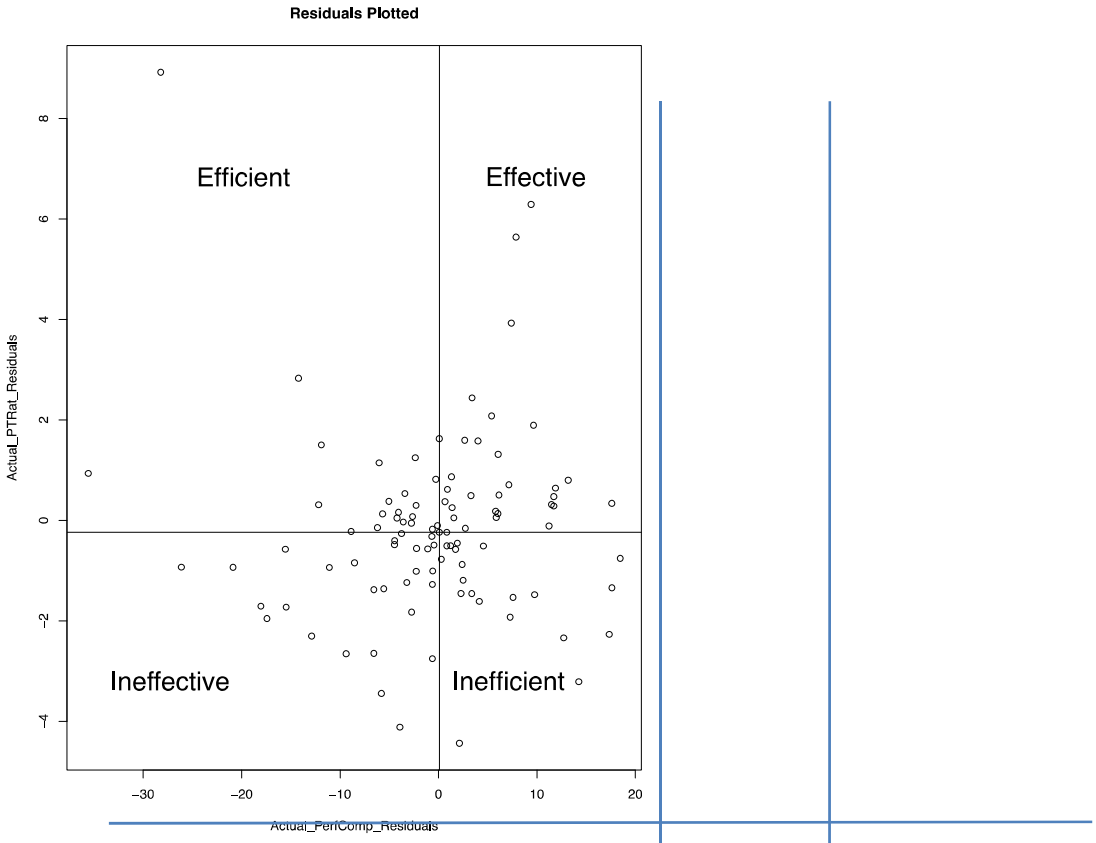


Figure 4.3 shows both the residuals that are excluded by the hold harmless cross as well as those that are considered to be efficient, effective, inefficient, and ineffective. The number within each quadrant is lower than at 0.1 because the hold-harmless of 0.5 is a more conservative estimate of efficiency than 0.1. Schools considered efficient at a 0.5 level are outperforming expectations at a higher level than at 0.1. The 0.5 level assumes that more variance is random and not systematic, and the data can be subjected to a more stringent test of efficiency. It is clear from Figure 4.3 that the majority of the schools plotted would be considered as part of a quadrant and not within the hold-harmless area at 0.1. This observation is in contrast to Figure 4.4 where the majority of schools plotted were excluded by the hold-harmless cross.

Figure 4.4: 0.5 Standard Deviation of the Median Quadriform



The 0.5 std. dev. level of the hold-harmless cross is a much more conservative standard for efficiency, effectiveness, inefficiency, and ineffectiveness than 0.1. As a result, there are fewer schools represented in each quadrant and more that are considered to be performing as predicted by the regression, and therefore removed from analysis.

Table 4.5: Population of Each Quadrant at Various Sizes of Hold-Harmless Cross

	No HH Cross	.1sd	.5sd
Efficient	29 (29.9%)	23 (23.7%)	6 (6.2%)
Effective	20 (20.6%)	16 (16.5%)	10 (10.3%)
Inefficient	28 (28.9%)	18 (18.6%)	8 (8.2%)
Ineffective	20 (20.6%)	23 (23.7%)	5 (5.2%)
Performing as Predicted	0 (0%)	17 (18%)	68 (70%)

Table 4.4 offers a look at the number of schools that populate each quadrant at three different hold-harmless sizes, based on percentages of the standard deviation, 0, 0.1, and 0.5. It also includes a breakdown of how many schools fall within the hold-harmless area and are established to be performing as predicted by the regression analysis. The number of schools said to be performing as predicted increases four-fold from the 0.1 with only 18% of schools performing as predicted to the 0.5 threshold, when 70% of schools are performing as predicted.

Table 4.6: Quadrant Residual Averages by Mean and Median

	Efficient	Effective	Inefficient	Ineffective
PerfComp Mean	-7.98	6.16	6.62	-7.54
PerfComp Median	-4.63	5.87	3.76	-5.02
PTRat Mean	0.94	1.14	-1.46	-1.42
PTRat Median	0.30	0.50	-1.40	-1.13

The average charter school in North Carolina, as defined by the mean, would fall at -0.615, -0.177, and be excluded from secondary analysis by the hold-harmless area, meaning that the average charter school in the state is performing as expected. Without the hold-harmless cross, the average charter school in North Carolina as calculated by the mean would be ineffective (meaning slightly fewer resources than expected and slightly lower performance than expected). Thus, the average school in this study is inefficient.

Characteristics of Quadrant Variables

The tables, as well as the analysis, answer the third research question in this study, "What alterable characteristics contribute to the relative efficiency/inefficiency of charter schools in the state of North Carolina?" The tables offer a breakdown of variables by quadrant, and specific insight into which variables may be most influential.

Table 4.7: 0.1 Std Dev Hold-Harmless Cross Analysis and Quadrant Mean Values

		Efficient	Effective	Inefficient	Ineffective
Demographics	% Black	0.27	0.30	0.31	0.40
	% Hispanic	0.07	0.04	0.05	0.08
	% API	0.02	0.03	0.01	0.01
	% White	0.60	0.54	0.55	0.46
	% Multi-Racial	0.03	0.03	0.04	0.04
	% Female	0.49	0.50	0.49	0.50
	% Male	0.51	0.50	0.51	0.50
	% IEP	0.12	0.13	0.14	0.09
	% ELL	0.03	0.01	0.01	0.16
Resources	PTRat	16.86	16.48	13.01	13.93
	PPE	8300.74	8989.38	8850.22	8752.44
Community	Wealth	1.15	1.07	1.06	1.08
	Effort	0.26	0.28	0.27	0.29
	County FRPL	55.54	62.55	56.41	65.54
N		23 (23.7%)	16 (16.5%)	18 (18.6%)	23 (23.7%)

At the 0.1 level of hold harmless, there are variables within each quadrant for which the values that are reasonably stable, such as API and gender. However, the county average for FRPL is quite variable, and is highest in the ineffective and effective quadrants. The PPE has a range between quadrants of nearly $600 per student, and the percentage of black students increases in succession through quadrants 1-4, or from efficient to ineffective, whereas higher percentages of Hispanic students are found in efficient and ineffective schools.

Table 4.8: 0.5 Std Dev Hold-Harmless Cross Analysis and Quadrant Mean Values

		Efficient	Effective	Inefficient	Ineffective
Demographics	% Black	0.56	0.33	0.41	0.34
	% Hispanic	0.14	0.04	0.07	0.05
	% API	0.01	0.00	0.01	0.01
	% White	0.25	0.58	0.48	0.56
	% Multi-Racial	0.04	0.04	0.03	0.04
	% Female	0.49	0.50	0.49	0.50
	% Male	0.51	0.50	0.51	0.50
	% ELL	0.05	0.01	0.03	0.01
	% IEP	0.11	0.15	0.18	0.11
Resources	PTRat	21.70	16.44	11.51	13.16
	PPE	8415.30	9949.90	9111.60	8271.60
Community	Wealth	1.45	1.00	1.05	1.23
	Effort	0.25	0.28	0.29	0.288
	County FRPL %	50.54	61.48	50.91	57.62
N		6 (6.2%)	10 (10.3%)	8 (8.2%)	5 (5.2%)

Table 4.8 presents results using the 0.5 approach advocated by Hickrod (1989), Rolle, (2003), and Genge (1991). In contrast to Table 4.7, using 0.1, efficient schools have the highest percentage of black students and the lowest percentage of white students. Efficient schools also have the highest percentage of ELL students, the highest PTRat, the highest community wealth score, and the lowest community effort scores. In addition, efficient schools have the lowest county average FRPL. Notably, across all quadrants, the male/female percentages never deviate more than 1 percentage point from 50. Also, the difference in PPE is largest at the 0.5 level between ineffective and effective by nearly $1,700 per student. The 0.5 level of the hold-harmless cross is a very conservative assumption, such that very few schools stand out per quadrant, especially as efficient.

Table 4.9: 0.1 Std Dev Efficient vs. Inefficient Quadrants

		Efficient	Inefficient	Difference
Demographics	% Black	0.27	0.31	-0.04
	% Hispanic	0.07	0.05	0.02
	% API	0.02	0.01	0.01
	% White	0.60	0.55	0.05
	% Multi-	0.03	0.04	-0.01
	% Female	0.49	0.49	0.01
	% Male	0.51	0.51	-0.00
	% IEP	0.12	0.14	-0.02
	% ELL	0.03	0.01	0.01
Resources	PTRat	16.86	13.01	3.85
	PPE	8300.74	8850.22	-549.48
Community	Wealth	1.15	1.06	0.09
	Effort	0.26	0.27	-0.01
	County FRPL	55.54	56.41	-0.87

Table 4.9 indicates that efficient schools have lower PPE than inefficient schools by nearly $500 and also have both the lowest overall percentage of black students at 27%, and the highest percentage of white students at 60%. There is a less than 1% difference in the county FRPL average and the wealth and effort scores are both within 0.1 of one another. Overall, the largest percentage variation among demographics is only 5%.

Table 4.10: 0.1 Std Dev Effective vs. Ineffective Quadrants

		Effective	Ineffective	Difference
Demographics	% Black	0.30	0.40	-0.10
	% Hispanic	0.04	0.08	-0.04
	% API	0.03	0.01	0.02
	% White	0.54	0.46	0.08
	% Multi-Racial	0.03	0.04	-0.01
	% Female	0.50	0.50	0.00
	% Male	0.50	0.50	0.00
	% IEP	0.13	0.09	0.04
	% ELL	0.01	0.16	-0.15
Resources	PTRat	16.48	13.93	2.55
	PPE	8989.38	8752.44	236.94
Community	Wealth	1.07	1.08	-0.01
	Effort	0.28	0.29	-0.01
	County FRPL	62.55	65.54	-2.99

Comparing the effective vs ineffective quadrants in table 4.10, the effective schools have 10% fewer black students, 8% more white students, and spend nearly $237 more per student, as defined by PPE. Again, the wealth and effort scores are within 0.1 of one another, but the FRPL lunch is nearly three percent higher on average in the ineffective schools (65.54 vs 62.55). The percentage of male and female students is the same – all 50% at effective and ineffective schools. Additionally, there are 2.55 more pupils per teacher in effective schools.

Table 4.11: 0.1 Std Dev Efficient + Effective vs. Inefficient + Ineffective

		E+E	I+I	Diff
Demographics	% Black	0.28	0.35	-0.07
	% Hispanic	0.06	0.07	-0.01
	% API	0.02	0.01	0.01
	% White	0.57	0.51	0.06
	% Multi-Racial	0.03	0.04	-0.01
	% Female	0.50	0.50	0.00
	% Male	0.50	0.50	0.00
	% IEP	0.12	0.12	0.00
	% ELL	0.02	0.09	-0.07
Resources	PTRat	16.67	13.47	3.20
	PPE	8645.06	8801.33	-156.27
Community	Wealth	1.11	1.07	0.04
	Effort	0.27	0.28	-0.01
	County FRPL	59.05	60.98	-1.93

In Table 4.11 there are 7% fewer black students in the efficient and effective quadrants than the ineffective and inefficient quadrants, as well as 6% more white students. The effective and efficient schools, on average, spend $156.27 less per student than the ineffective and inefficient schools, and the effective and efficient schools average over 3 more pupils per student than the ineffective and inefficient schools do. Finally, the county average of FRPL is nearly 2% higher in ineffective and in inefficient schools than effective and efficient schools.

Table 4.12: 0.5 Std Dev Efficient vs. Inefficient Quadrants

		Efficient	Inefficient	Difference
Demographics	% Black	0.56	0.33	0.23
	% Hispanic	0.14	0.04	0.1
	% API	0.01	0	0.01
	% White	0.25	0.59	-0.34
	% Multi-Racial	0.04	0.04	0
	% Female	0.49	0.5	-0.01
	% Male	0.51	0.5	0.01
	% IEP	0.11	0.15	-0.04
	% ELL	0.05	0.01	0.04
Resources	PTRat	21.7	16.44	5.26
	PPE	8415.33	9949.90	-1534.57
Community	Wealth	1.21	1	0.21
	Effort	0.29	0.28	0.01
	County FRPL	49.43	61.48	-12.05

In Table 4.12, the difference between the quadrants is greater as the result of a more stringent standard of efficiency, inefficiency, effectiveness, and ineffectiveness at the 0.5 application of the hold-harmless cross as opposed to 0.1. The difference in FRPL is over 12 % between efficient and inefficient schools compared to only 1.93% at the 0.1 level. Additionally, there are 23% more black students at efficient schools than at inefficient schools at the 0.5 level which is in contrast to the 0.1 level where there were 29% more white students. There are 10% more Hispanic students, 34% fewer white students, and over 5 more pupils per teacher at efficient schools than at inefficient schools. Finally, efficient schools spend $1,534.57 less per student than inefficient schools at the 0.5 level, as opposed to only $156.27 at the 0.1 level.

Table 4.13: 0.5 Std Dev Effective vs. Ineffective Quadrants

		Effective	Ineffective	Difference
Demographics	% Black	0.41	0.34	0.07
	% Hispanic	0.07	0.05	0.02
	% API	0.01	0.01	0
	% White	0.48	0.56	-0.08
	% Multi-Racial	0.03	0.04	-0.01
	% Female	0.49	0.51	-0.02
	% Male	0.51	0.49	0.02
	% IEP	0.18	0.1	0.08
	% ELL	0.03	0.0	0.03
Resources	PTRat	11.51	13.16	-1.65
	PPE	9111.63	8271.60	840.03
Community	Wealth	1.05	1.23	-0.18
	Effort	0.29	0.29	0
	County FRPL	50.91	57.62	-6.71

Table 4.13 shows that there is no difference in county effort scores between effective and ineffective schools, and a 0.18% difference in wealth between them, as well as a 6.71% difference in average FRPL. Effective schools spent just over $840 per pupil more than ineffective schools, and ineffective schools had 1.65 more pupils per teacher than effective schools. There are 8% fewer white students at effective schools, 7% more black students, and 2% fewer female students.

Table 4.14: 0.5 Std Dev Efficient + Effective vs. Inefficient + Ineffective

		E+E	I+I	Difference
Demographics	% Black	0.89	0.75	0.14
	% Hispanic	0.18	0.12	0.06
	% API	0.01	0.02	-0.01
	% White	0.84	1.04	-0.2
	% Multi-Racial	0.08	0.07	0.01
	% Female	0.99	0.99	0
	% Male	1.01	1.01	0
	% IEP	0.26	0.28	-0.02
	% ELL	0.06	0.03	0.03
Resources	PTRat	38.14	24.67	13.47
	PPE	18365.23	17383.23	982
Community	Wealth	2.21	2.28	-0.07
	Effort	0.57	0.58	-0.01
	County FRPL	110.91	108.53	2.38

The effective and efficient schools had 13 more pupils per teacher than the ineffective and inefficient schools, but spent $982 more per pupil. There was a 2.38% difference in the county FRPL average, and less than a 0.1% difference in either the wealth or effort numbers. The efficient and effective schools had 14% more black students, 6% more Hispanic students, and 2% fewer white students than their inefficient and ineffective counterparts.

One hypothesis is that efficient schools are allowing larger class sizes and moving resources into support staffing/administrative staffing. Tables 4.15–4.17 examine this hypothesis, breaking down staffing levels by hold-harmless cross size.

Table 4.15: Staffing Levels at 0.0 Hold Harmless Level

	Teachers Per Pupil (x100)	Admins Per Pupil (x100)	Guidance Per Pupil (x100)	Admins > 0	Guidance > 0
Efficient 0	6.21	0.10	0.13	38%	50%
Effective 0	6.15	0.13	0.08	28%	39%
Inefficient 0	7.77	0.07	0.17	26%	65%
Ineffective 0	7.43	0.13	0.21	30%	45%

At the 0.0 hold-harmless size, the number of pupils per teacher is lower than both inefficient and ineffective schools, which is line with much of the literature regarding student achievement and pupil-teacher ratio and/or class size. Interestingly, both the number of administrators and guidance counselors per pupil are the second lowest in the efficient category.

Table 4.16: Staffing Levels at 0.1 Hold-Harmless Level

	Teachers Per Pupil (x100)	Admins Per Pupil (x100)	Guidance Per Pupil (x100)	Admins > 0	Guidance > 0
Efficient 0.1	6.22	0.11	0.14	35%	52%
Effective 0.1	6.38	0.12	0.08	28%	39%
Inefficient 0.1	8.22	0.09	0.13	29%	53%
Ineffective 0.1	7.55	0.19	0.18	35%	43%

In Table 4.16 it is clear that there is little difference between administrators per pupil, except in the ineffective quadrant, which is appropriate as the schools labeled ineffective at the 0.1 level are spending more money and getting lower academic output relative to the others. It is interesting that the top two levels of guidance counselors per student are efficient and ineffective, which informs Table 4.18, showing that the largest number of guidance counselors per school at the 0.1 level is in the efficient quadrant, with the second highest in the ineffective.

Table 4.17: Staffing Levels at 0.5 Hold-Harmless Level

	Teachers Per Pupil (x100)	Admins Per Pupil (x100)	Guidance Per Pupil (x100)	Admins > 0	Guidance > 0
Efficient 0.5	4.56	0.14	0.04	40%	20%
Effective 0.5	6.27	0.22	0.11	50%	40%
Inefficient 0.5	8.98	0.09	0.21	25%	63%
Ineffective 0.5	7.84	0.34	0.05	60%	20%

Table 4.17 shows that at the 0.5 level of the hold-harmless cross, the difference between quadrants is the most pronounced. For example, the efficient schools at 0.5 have at least 1.5 fewer teachers per pupil when compared to the other quadrants. They also have the fewest guidance counselors and the second fewest administrators. The data seem to indicate that efficient charter schools in North Carolina are lean organizations, with relatively low levels of administrative and support staff.

Table 4.18: Average Number of Guidance Counselors Per School Across Quadrants

Guidance Counselors	Efficient	Effective	Inefficient	Ineffective
0.0	0.75	0.49	0.73	0.84
0.1	0.80	0.46	0.47	0.71
0.5	0.26	0.31	0.50	0.76

Table 4.18 highlights an alternate view of the data concerning guidance counselors, as they were referenced by Houck, Rolle, and He (2010) as important to student success. The table shows the average number of guidance counselors per school in each quadrant at the 0.1 and the 0.5 level. As in the per-student breakdown in tables 4.15-4.17, the largest numbers are in the efficient and ineffective schools at the 0.0 and 0.1 levels. Interestingly, the efficient number drops at the 0.5 level, while the inefficient grows higher than at 0.1.

Table 4.19: Average Number of Administrators Per School Across Quadrants

Administrators	Efficient	Effective	Inefficient	Ineffective
0.0	0.37	0.27	0.24	0.31
0.1	0.37	0.28	0.26	0.39
0.5	0.41	0.51	0.18	0.73

Offering context to Table 4.18, Table 4.19 shows the average number of administrators per school across quadrants at the various levels of the hold-harmless cross. Similar to the breakdown of guidance counselors per school in Table 4.18, the efficient and ineffective quadrants have the most administrators per school at the 0.0 and 0.1 level, but the effective schools have more at the efficient level. Again, it is interesting that the efficient number drops at the 0.5 level, while the inefficient grows higher than at 0.1. The only dramatic increase is in the ineffective quadrant from 0.1 to 0.5, which is logical as more administrators are more expensive.

Summary of Findings

The data generated by the multiple regression analyses and the application of the modified quadriform at various levels of hold-harmless cross size, offer the following findings:

- The 0.5 hold-harmless level is a more effective evaluative tool than the 0.1 level
- PTRat works better than PPE as an input variable to study predicted resources/performance in schools
- PTRAT matters as a discriminatory variable more than previously thought
- Guidance counselors per school seem to matter across quadrants
- Administrators per school seem to matter across quadrants
- Gender does not have a significant effect on the results
- Percentage of Asian/Pacific Islander students does not have a significant effect on the results
- Community wealth seems to matter at all levels of the hold-harmless cross

CHAPTER 5: DISCUSSION AND CONCLUSIONS

Introduction

Chapter 5 of this dissertation seeks to answer the study's research questions utilizing the findings detailed in Chapter 4, and to further the discussion of the study's results. Where applicable, recommendations are made for amendments and future research. The chapter begins with a focus on the research questions and ends with a reflection on the process, including suggestions for further investigation and implications for policy changes.

The purpose of this study was to explore charter schools in North Carolina from the perspective of relative economic efficiency. The study sought to analyze academic outcomes in the context of economic inputs to determine relative charter school efficiency as a baseline for further analysis. To determine efficiency, the modified quadriform was applied to the residual (error) results of a multivariable statistical analysis, and to establish quadrants of relative efficiency among charter schools in North Carolina.

This study is a proof of concept, as the modified quadriform analysis had never been used to analyze only charter schools. The modified quadriform itself created the lens for analysis, and while there was no specific treatment utilized or evaluated, the discriminatory analysis of the alterable characteristics suggests several potential research directions and identifies the relationship between alterable characteristics examined and relatively efficient schools. After a baseline of relative efficiency was established through the regression analysis, the schools within each quadrant were analyzed to determine which alterable characteristics may have affected

academic outputs. Finally, this study also sought to establish a model for further investigation of charter schools.

In answering the research questions, the following themes arose: school type and availability of data; pupil-to-staff ratios; county wealth, race/ethnicity, and IEP designation as they relate to efficiency; and the manner in which money is spent in schools.

Answering the Research Questions

This section aims to answer the research questions that were posed in Chapter 1, and to link them to the analysis of the data generated and highlighted in Chapter 4. To accomplish the analysis, data from this study will be reviewed, literature and previous studies will be referenced, and discriminatory analysis will be produced.

1) **Can the modified quadriform be used to evaluate the relative efficiency of charter schools?**

In keeping with the study's purpose, the first research question asked was: "Can the modified quadriform be used to evaluate the relative efficiency of charter schools?" In short, yes. As explained and modeled in Chapter 4, there were some deviations from the proposed model (such as using a county average FRPL variable, as well as a county wealth and effort index in the absence of a school-by-school measure as is common in TPS). The adjusted R^2 values generated were high, and the results were consistent with expectations based on previous studies. This study successfully regressed the data available, plotted residuals on a XY axis, and overlaid the modified quadriform, assigning each school to a quadrant or holding them harmless if they were performing as expected. After assigning quadrants, a secondary analysis was performed. Alterable characteristics were identified for each quadrant, as well as the position of

the average school in each quadrant. Finally, results were analyzed to identify key differences between quadrants.

As mentioned in Chapter 2, the modified quadriform has been used to evaluate school districts and individual schools across the United States, from Georgia (Houck, Rolle, and He, 2010) to Indiana (Rolle, 2004), to Texas (Stephens, 2007). This study applied PTRat as the input variable in place of PPE and successfully used the modified quadriform to evaluate charter schools. This should make the modified quadriform analysis much more accessible to researchers, even in states where there is not a lot of public information regarding charters.

2) How economically efficient are charter schools in North Carolina, in terms of financial inputs vs. academic outputs?

Second, this study asked the question: "How economically efficient are charter schools in North Carolina, in terms of financial inputs vs. academic outputs?" As the study progressed through regression models of both financial inputs and academic outputs, which variables were assessed differed. Ultimately, the model chosen for predicting input abandoned utilizing PPE. Rather, in a reflection of both Hanushek (1996) and Rolle (2004)—who assert that the amount of money spent matters less than how the money that is spent is distributed—PTRat was utilized, as it is still a measure of financial input and also represents a conscious decision regarding the distribution of the per-pupil-expenditure.

To investigate the relative efficiency of the charter schools in North Carolina, the modified quadriform was applied with a hold-harmless cross at two different sizes, 0.1 of a standard deviation and 0.5 of a standard deviation. The data was plotted, and it clustered closely. The 0.1 level of the hold-harmless cross created rather large quadrant populations and did not do an effective job of removing the schools that were performing as predicted, especially relative to

one another. Conversely, at the 0.5 level, the quadrant populations are much smaller, and offer a more accessible and conservatively established set of representative schools.

Since the quadrant populations at 0.5 are smaller and represent the schools that are performing outside of predicted levels as compared to the 0.1 analysis, these populations bear further scrutiny. Whereas 30% of Georgia districts and 32% of all Texas school districts were efficient using the modified quadriform approach, only 6% of North Carolina charters were deemed efficient.

In one respect, this would make sense because charters are supposed to be, in their earliest form, places for experimental curricula and innovative teaching, which would naturally be hit or miss. However, charters in North Carolina are no longer seen as an avenue for exploring the craft of teaching, but rather as schools that are noticeably different from their traditional counterparts, although funded by the same tax dollars. The lack of efficiency relative to public school districts is further troubling as the charter school connection to a market approach –as even highlighted by the NC General Assembly (§N.C.G.S. 115C) – yet they are dramatically underperforming their competition within that marketplace. In a true market environment, charter school numbers should be shrinking as they are not meeting their stated purpose relative to their national competition.

Figure 5.1: PTRat and PerfComp Residuals Plotted

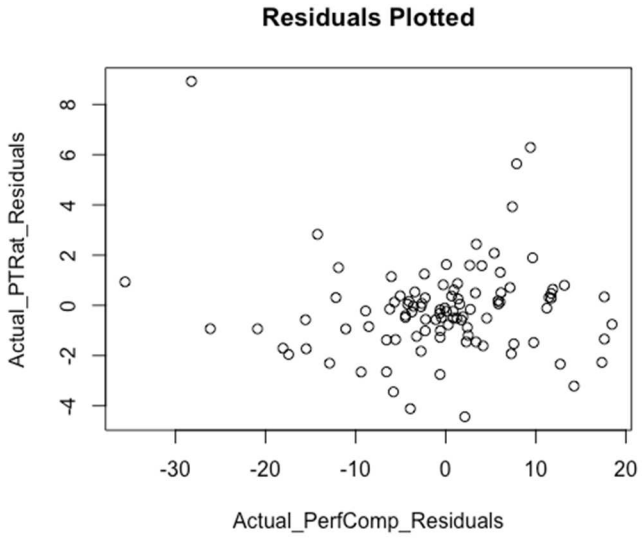


Table 5.1: Population of Each Quadrant at Various Sizes of Hold-Harmless Cross

	0.0	.1sd	.5sd
Efficient	29 (29.9%)	23 (23.7%)	6 (6.2%)
Effective	20 (20.6%)	16 (16.5%)	10 (10.3%)
Inefficient	28 (28.9%)	18 (18.6%)	8 (8.2%)
Ineffective	20 (20.6%)	23 (23.7%)	5 (5.2%)
Performing as Predicted	0 (0%)	17 (18%)	68 (70%)

Looking at the 0.1 level pf hold harmless and considering research question #2, 23.7% of North Carolina charter schools are efficient. Interestingly, at the same 0.1 level of hold harmless, Houck, Rolle, and He (2010) found that 30% of Georgia school districts were efficient, and Stevens (2007) found that 32.3% of all Texas school districts were efficient, meaning that at the same standard of conservatism (albeit with less complete data), North Carolina charter schools had the lowest percentage of efficiency compared to other studies.

Table 5.2: Comparison of Quadrant Percentages Across Studies

Studies	Efficient	Effective	Inefficient	Ineffective
Sturdevant (2017) 0.1	23.7	16.5	18.6	23.7
Sturdevant (2017) 0.5	6.2	10.3	8.2	5.2
Houck, Rolle, He (2010)	30	20	23	27
Stevens (2007)	32.2	19.5	30.8	17.5

To revisit the research question at the 0.5 level of hold harmless, there are more effective/inefficient/ineffective schools than efficient, but more effective schools than ineffective. It is reasonable to conclude from the data that most schools, 69/98 or 70.41%, were performing as expected. Also, while there are relatively efficient charter schools in North Carolina, at 6/98 or 6.2%, they are a small proportion of the state's charters. So, in terms of financial inputs vs. academic outputs, which was the focus of this investigation, North Carolina charter schools as a whole are not efficient, but do consistently perform as expected, with only 13/98 (13.25%) categorized as ineffective or inefficient.

3) What alterable characteristics contribute to the relative efficiency/inefficiency of charter schools in the state of North Carolina?

Third, the study sought to answer the question: "What alterable characteristics contribute to the relative efficiency/inefficiency of charter schools in the state of North Carolina?" Answering this question produced the most interesting results of the entire study, and the details are outlined in tables 4.7 through 4.14. Consistently these tables show that API and gender do not have a large impact. API% ranges from 0.1 to 0.3 and the ratio of male to female never ventures past 0.49/0.51 or vice versa.

When evaluating the data in this study and drawing conclusions, it is important to keep in mind that the 0.5 measure is a much more stringent measure of efficiency than the 0.1 level, and

as such, isolates those schools that are over-performing compared even to their successful peers. Also, the points graphed on the scatterplot represent how different the actual input/output is from what the regression predicted it would be, which means that schools considered efficient at a 0.5 level are considerably outperforming their expected results based on variables used such as student demographics, school resources, and measures of community wealth.

Table 5.3: 0.5 Std Dev Efficient vs. Inefficient Quadrants

		Efficient	Inefficient	Difference
Demographics	% Black	0.56	0.33	0.23
	% Hispanic	0.14	0.04	0.1
	% API	0.01	0	0.01
	% White	0.25	0.59	-0.34
	% Multi-Racial	0.04	0.04	0
	% Female	0.49	0.5	-0.01
	% Male	0.51	0.5	0.01
	% IEP	0.11	0.15	-0.04
	% ELL	0.05	0.01	0.04
Resources	PTRat	21.7	16.44	5.26
	PPE	8415.33	9949.9	-1534.57
Community	Wealth	1.21	1.00	0.21
	Effort	0.29	0.28	0.01
	County FRPL	49.43	61.48	-12.05

Table 5.4: 0.1 Std. Deviation Efficient vs. Inefficient Quadrants

		Efficient	Inefficient	Difference
Demographics	% Black	0.27	0.31	-0.04
	% Hispanic	0.07	0.05	0.02
	% API	0.02	0.01	0.01
	% White	0.60	0.55	0.05
	% Multi-Racial	0.03	0.04	0.00
	% Female	0.49	0.49	0.01
	% Male	0.51	0.51	-0.01
	% IEP	0.12	0.14	-0.03
	% ELL	0.03	0.01	0.01
Resources	PTRat	16.86	13.01	3.85
	PPE	8300.74	8850.22	-549.48
Community	Wealth	1.15	1.06	0.09
	Effort	0.26	0.27	-0.01
	County FRPL	55.54	56.41	-0.87

To frame the discussion of tables 5.2 and 5.3, the following quote from Houck, Rolle, and He (2010, p. 349) is helpful:

> Overall analysis would suggest that higher-performing [efficient] districts are located in wealthier communities, spend less per pupil and on special education, and dedicate higher percentages of funds to counselors and to instruction than their lower performing peers.

Houck and colleagues' study of school district efficiency in Georgia is a good model for this study. First, Georgia is geographically similar and has a similar population. It is also the most recent of the major quadriform studies, and includes some of the most thorough analysis in the literature. Stevens (2007), who analyzed school districts in Texas, adds a recent and interesting geographic comparison.

Tables 5.1 and 5.2 show that IEP students do not make a significant difference in the efficient vs. inefficient classification in this study, a difference of 3% at the 0.1 level and 4% at

the 0.5 level. This represents a departure from Houck, Rolle, and He (2010), who found that higher performing districts spend the least on special education, and the difference in spending on special education between efficient and inefficient schools was statistically significant. One reason for this difference may be that charter schools are options within the spectrum of public schools in North Carolina, but not subject to the same requirements. Therefore, charters can choose to offer fewer services, accommodations or other benefits to IEP students than a TPS would need to offer.

Another possibility, in both North Carolina and Georgia is that both states boast a thriving independent school community, and many of those schools are targeted toward IEP students. In Houck, Rolle, and He (2010), the authors conclude that efficient districts are both wealthy and have the lowest money spent on special education. There may be a correlation between district wealth and the ability to attend an independent school that is targeted toward IEP students.

Guidance Counselors

Table 5.5: Average Number of Guidance Counselors Per School Across Quadrants

Guidance Counselors	Efficient	Effective	Inefficient	Ineffective
0.0	0.75	0.49	0.73	0.84
0.1	0.80	0.46	0.47	0.71
0.5	0.26	0.31	0.50	0.76

Another observation about efficient schools from Houck, Rolle, and He (2010) is that efficient school districts dedicate a greater percentage of their budgets to counselors. Table 5.4 details the average number of counselors per school at in each quadrant and at each level of stringency. It is important to note that Houck and colleagues used a 0.1 hold-harmless level in their study, and at the 0.1 level in this study, the same conclusion holds true. This is a departure

from other studies that identify PTRat as the most important variable in predicting student success, including Stevens (2007) who came to that conclusion on his study of Texas school districts. Based on this study and Houck, Rolle, and He (2010), at the 0.1 level of a hold-harmless cross, support outside of the classroom seems to help student performance.

Interestingly however, the second and third lowest number of counselors at both the 0.1 and the 0.5 levels exist in the effective quadrant, which is the quadrant in which schools spend the most per student. This detail in the data is further complicated by the fact that the average community wealth score is the second lowest at both the 0.1 and the 0.5 level. However, the lowest observation in Table 5.4, the 0.5 efficient quadrant, has only 0.25 counselors per school, on average. This low number, and its departure from Houck et. al (2010), may be the result of the extreme disproportion of the community wealth score. Schools that are efficient at the 0.5 level have a community wealth score that is .2 higher than ineffective, and nearly .5 higher than the effective and inefficient quadrants as highlighted in Table 5.5. This not only correlates with Houck and colleagues, but informs the low number of counselors. In a wealthy community, the significant college or social emotional guidance is often taken care of outside of the school building, and the financial demographics of the communities in the quadrant indicate that paying for such services would not be a comparative hardship.

Table 5.6: Community Wealth Averages at 0.1 and 0.5 by Quadrant

	Efficient	Effective	Inefficient	Ineffective
0.1	1.15	1.07	1.06	1.08
0.5	1.45	1.00	1.05	1.23

Of the schools studied in this investigation and those by Houck, Rolle, and He (2010) and Stevens (2007), charters in North Carolina have the lowest overall percentage of efficient schools at the 0.1 level, and that across the board, the state's charters average less than one guidance

counselor per school. Findings at the 0.1 level in both the Houck, Rolle, and He (2010) study and this study indicate that relatively efficient schools spend more on student support. Perhaps the comparatively low number of guidance counselors in N.C. charter schools is a correlative to the lowest percentage of efficiency result.

Further, there are serious equity concerns highlighted in Table 5.6, particularly at the 0.5 level. That the county wealth average is more than 0.2 higher in efficient schools than any other quadrant shows just how much harder it is for lower income students to get the same education as high income students. Considering that N.C. charter schools are charged with serving students in low-resource areas, this finding is alarming. It highlights an equity concern that charters in this state may be more successful when serving already well-resourced populations.

Summary: What Matters?

The answer to research question #3 is that several factors influence charter school efficiency—some are alterable, but many are not. Community wealth is a factor, as is FRPL percentage, and both are unalterable. The number of guidance counselors, the percentage of black and white students, and the PTRat all matter. All of these factors are alterable, although some more easily than others.

Table 5.7: PTRat Across Quadrants at 0.1 and 0.5

	Efficient	**Effective**	**Inefficient**	**Ineffective**
0.1	16.86	16.48	13.01	13.93
0.5	21.70	16.44	11.51	13.16

The PTRat is more than five pupils per teacher higher for efficient schools than in effective schools (the next highest level) at the 0.5 level, and seems to correlate with both the

literature and the Houck et al. (2010) study. It also makes sense that an efficient school would have the fewest teachers per pupil. However, the dramatic difference in numbers seems to imply that the teachers must have a degree of experience and expertise as they are still achieving strong performance results relative to expectations. In this way, the N.C. charter school data produce the same conclusion as Houck et al. (2010), that lower PPE and higher instructional expenditures are indicators of an efficient school.

While this study found that higher PTRat was associated with efficiency, which is a departure from Stevens (2007), the idea that teachers in efficient schools are likely more experienced is actually supported by Stevens. He reported that one of the highest predictors of school efficiency was teacher experience, with higher levels of experience correlating to higher efficiency. That those two variables diverge in this study, may bear further investigation.

PTRat is consistently the highest in the efficient quadrant, by 0.4 pupils per teacher at 0.1 and by 5.26 pupils per teacher at 0.5. It is safe to say that a higher PTRat is associated with efficiency, but that does not mean that charter schools should start pulling teachers out of the classroom, as the other variable that is consistently highest in the efficiency sector is county wealth. Conversely, in the efficient quadrant the county effort is consistently the lowest (0.26 at 0.1 and 0.25 at 0.5), as is the county FRPL. That a higher PTRat is associated with efficiency refutes the earlier hypothesis in Chapter 3, that a lower PTRat would be associated with higher efficiency based on Stevens (2007). It is also a departure from a significant body of literature. For example, Alspaugh (1994) studied a sample of 60 schools to determine the effect of PTRat on the efficiency of the schools. He concluded that increases in class size were positively correlated with increased efficiency, and in some cases, also correlated with an increase in achievement.

In 1995, Mosteller published the results of the Tennessee STAR study, concerning class size and student achievement. Conducted in three phases, the study examined short-term and long-term student achievement and its relationship to class size. The four-year study found compelling evidence to support a positive effect of small class size, especially in earlier grades. The conclusions from the STAR study mirror the conventional wisdom in the post-ESEA world but not the data, where pupil-to-teacher ratios have fallen by almost a third as educational spending has ramped up and national student achievement has declined. However, it is important not to confuse the variable of PTRat and class sizes. While schools have more teachers in a building than they used to, they may also serve many more students per classroom; the variables are not necessarily linked. Unfortunately, there is no data available to study class sizes within the N.C. charter school system, but a study of that nature would fill a gap in the literature.

Finally, Houck, Rolle, and He (2010) addressed community wealth as one of the indicators of an efficient school district in Georgia. In addition to playing a role in the discussion of guidance counselors, community wealth is consistently the highest in the efficient quadrant at both 0.1 and 0.5 levels. As seen in Table 5.5, the community wealth levels of other quadrants are relatively equal, except for the ineffective quadrant at 0.5. It is also interesting to note that at the 0.5 level, there is a 12% difference in the average FRPL percentage between efficient schools (49.43%) and inefficient schools (61.48%). In these ways, the N.C. charter schools data reach the same conclusion as Houck et al.; community wealth matters.

A noteworthy divergence from previous studies is that PPE is higher in inefficient schools ($8,850.22 at 0.1 and $9,949.90 at 0.5) than in efficient schools ($8,300.74 at 0.1 and $8,415.33 at 0.5), but PPE is higher in effective schools ($8,989.38 at 0.1 and $9,111.63 at 0.5)

than in ineffective schools ($8,752.44 at 0.1 and $8,271.60 at 0.5). Overall, effective schools have the highest PPE at both 0.1 ($8,989.38) and 0.5 ($9,949.90), while at 0.1 efficient schools have the lowest PPE ($8,300.74), and at 0.5 ineffective schools have the lowest PPE ($8,271.60).

Another intriguing finding in this study is that based on a hold-harmless level of 0.1, there is not much to say about creating an efficient school except that having slightly fewer teachers per pupil is helpful. However, at the 0.5 level, the story is quite different. At the 0.5 level, having more black students, at least five more pupils-per-teacher, and living in an affluent county correlate with increased efficiency. What might account for the difference is that schools at the 0.5 level (held to a more stringent standard of efficiency) are minority-majority schools that are outperforming the expectations of the regression based on the performance of schools with similar demographics. Meanwhile at 0.1 (a less stringent standard of efficiency), the common narrative of the racial performance divide in schools persists.

Houck, Rolle, and He (2010, p. 352), among their three main conclusions offered the following:

> Teacher quality matters – Teacher salary and experience were associated with average district productivity. While increased salary was linked to efficiency productivity, teacher experience was linked to high performance. The negative association between experience and average efficiency indicates that experience alone is not a determining factor.

As mentioned in Chapter 2, Hanushek (1996), Rolle (2004), and Houck and Rolle (2004) have all asked or answered the question "Does money matter?" Generally, all three answer both yes and no. The amount of money doesn't matter nearly as much as the manner in which the money is spent. That conclusion is also reflected in this study. The schools with the highest PPE are effective at both levels of the hold-harmless cross, while the efficient schools have the lowest PPE at 0.1 and second lowest at 0.5. More specific to the point made by Houck et al. is that the

PTRat is highest among the efficient schools at both the 0.1 and 0.5 levels, which is a divergence from conventional wisdom and previous studies (Stevens, 2007; Alspaugh, 1994). In this study, the availability of student support (as highlighted by the number of guidance counselors per student) seems to matter when measuring student success.

4) Is the modified quadriform analysis a potentially beneficial means of evaluating charter school efficiency?

Finally, the study asked: "Is the modified quadriform analysis a potentially beneficial means of evaluating charter school efficiency?" The answer to this question is: yes. As charter schools are subject to their own set of rules and regulations that differ from both TPS and independent and/or parochial schools, there is a need for efficiency research, and the modified quadriform analysis allows for the schools to be compared in context, relative to one another.

This study showed that the modified quadriform can be successfully applied to charter schools, and that future studies can build upon this research to identify trends and patterns, and to provide other valuable insights. The potential benefit of the modified quadriform in evaluating charter school efficiency is undeniable. In addition, the flexibility of the modified quadriform to highlight different levels of the hold-harmless cross in the analysis, and to allow for layered analysis of the same dataset is valuable for researchers and policymakers alike.

Limitations

This study was a successful investigation and proof-of-concept for the utilization of the modified quadriform on charter school data in North Carolina. However, as with most investigations, the scope and size of this study limited the proverbial ground that the research could cover.

Limitations from Chapter 1

1. This is a one-year, proof-of-concept study, and does not afford the clarity of data trends or student growth/regression that a longitudinal study would.

2. The measure for county affluence is accurate for the county taken in total, but individual schools may be located in much more or less affluent areas than the county average, meaning that the student bodies may differ from the county average.

Reflecting upon the expected limitations of this study, the narrow scope of the data means that quadrant trends over time, both in terms of the schools within the quadrants and how they move around the quadriform, cannot be determined. It is a double-edged sword to use public data. It is often the only data available and can offer years of consistent datasets, but it is also slow to be generated, and can be less precise or specific than would be optimal for a narrow study.

Another limitation was the availability of school-level data for charter schools. Utilizing county averages was effective to achieve a high Adj. R^2 for this study, but failed to account for counties that may have drastically different urbanity levels for charter school locations within the same county.

Additional Limitations

There is a variable that is not included in the study, but with a greater volume of schools could prove interesting, and that is school type. Charter school grade spans are nontraditional and often change as schools grow or shrink. As they are not required to conform to the public school model, the variation among only 98 schools, from elementary, to K-12, to a more random spread of grades, made the variable too weak to calculate. However, there is literature that suggests it might have a significant impact on research results. Howley (2002) argued that specifically, where grades 6 and 7 are placed in relationship to their surrounding grades (5 and 8) can have a significant impact on student achievement. As charter schools do not have to

conform to the public-school model, the variation in grades in the 98 schools makes this difficult to take into account. However, with a greater volume of schools, the addition of that variable could prove interesting.

Policy Considerations

Increased Access to Information

One policy consideration that would greatly aid in making charter schools transparent and researchable would be to increase the availability of data. Some of the deviations from previously established modified quadriform analysis procedures for traditional public school models occurred to compensate for the lack of categorical data, or lack of building level data. As the saying goes, perfect markets operate with perfect information. As charter schools exist to increase choice among public schools (which implies a marketplace), the availability of information would be practical and consistent with their stated purpose.

One specific dataset that would be helpful is teacher and administrative salaries. Houck, Rolle, and He (2010) found that there was a link between average performance and the distribution of funds within the school. Specifically, administrative funding was linked to inefficiency, and instructional spending was linked to increased performance— both effectiveness and efficiency. While higher paid, more experienced teachers can make it difficult to achieve efficiency due to high salary expenditures, they can also allow for a greater PTRat, which boosts efficiency.

A second dataset that would further research of charters and establish a new segment of the literature regarding student achievement is class size data. The ability to benchmark the achievement of charter school students in view of their average class sizes relative to their TPS

peers or to one another would allow for comparisons to STAR study results (Mosteller, 1995) and contribute to the efficiency literature regarding charters.

Further Research Considerations

Critical Race Theory

A possible investigational direction for this study would involve a critical race lens for the data and conclusions. There are several interesting divergences that relate to race. At the 0.1 hold-harmless level, the efficient quadrant has the lowest percentage of black students (27%), whereas at the 0.5 hold harmless level it has the highest (56%). Additionally, the percentage of white students is highest in the efficient quadrant at 0.1 (60%), while at 0.5 it is the lowest (25%). Additionally, at the 0.5 hold-harmless level, the percentage of Hispanic (14%), multiracial (4%), and ELL students (5%) is highest in the efficient quadrant, whereas none of them are the highest at the 0.1 hold-harmless level.

Using the MQA to Identify Trends

This study sought to establish a baseline for utilizing the MQA to analyze charter schools in North Carolina. Now that the model has been established, a future study could interpret data from multiple years and track both the changes in the quadriform itself (the definitions of the quadrants on the scatterplot) and the schools that exist within the quadrants, tracking if and where they move about the quadriform.

Directions for Further Research

Future analysis of the traditional public schools in North Carolina using a modified quadriform would offer a direct comparison with charters. It would also allow researchers to evaluate both charters and traditional schools in context and compare distribution of efficient

schools. Another possible study could begin with data collection directly from the charter sector similar to that of traditional public schools, which would facilitate direct comparisons.

To follow this study specifically, an interview with the leaders of the six efficient schools (under .05) and the eight inefficient schools (.05) would offer the chance for a qualitative analysis to complement the quantitative, as well as some insight into the effect of leadership styles outside of a traditional public school model.

Conclusions

Depending on the level of scrutiny (0.1 or 0.5), there are either several charter schools that perform as expected or the majority of them perform as expected, which is not a bad finding. It is not reasonable to believe that a school will start out as an efficient organization, and many charter schools in North Carolina are fairly new. The laws for charter schools are only about 20 years old, and most of the institutions are significantly younger than the law. As Education Secretary Riley claimed, emulating an independent school model could benefit schools, and the charter model seeks to do that in many ways.

This investigation was a successful proof-of-concept study. It offers a foundation for further investigation into charter schools utilizing the Modified Quadriform Analysis (MQA), or even into traditional public schools utilizing PTRat as the input variable as opposed to the traditional PPE. The research questions were successfully answered, and the study accomplished its purpose of investigating the relative efficiency of charter schools in North Carolina. Further, this study expands the literature concerning the MQA, and adds a dimension to efficiency studies in the expanding arena of charter school education, equipping researchers and educators with a tool to evaluate the sector.

It is also interesting to note that despite a relatively low level of efficiency among charter schools in North Carolina, the sector has continued to grow. It is celebrated as a success by lawmakers and their constituents, based upon their voting behaviors. It is reasonable to infer then that charter schools serve a purpose beyond simply improving the input-output relationship in schools, or offering innovations in curriculum and instruction. Researchers interested in studying charter schools that fall outside of the efficiency quadrant may be able to use the results from this study to inform their investigation of charter school growth, functions, and services.

APPENDIX A

Charter School Quadrant Rankings at 0.0, 0.1, and 0.5

Table A.1: Efficient

0.0	0.1	0.5
CLOVER GARDEN	CLOVER GARDEN	ALPHA ACADEMY
RIVER MILL ACADEMY	RIVER MILL ACADEMY	CENTRAL PARK SCHOOL FOR CHILDREN
WASHINGTON MONTESSORI	WASHINGTON MONTESSORI	QUALITY EDUCATION ACADEMY
EVERGREEN COMMUNITY CHARTER	EVERGREEN COMMUNITY CHARTER	SUCCESS CHARTER SCHOOL
CAROLINA INTERNATIONAL SCHOOL	CAROLINA INTERNATIONAL SCHOOL	CASA ESPERANZA MONTESSORI
WOODS CHARTER SCHOOL	WOODS CHARTER SCHOOL	
ALPHA ACADEMY	ALPHA ACADEMY	
CENTRAL PARK SCHOOL FOR CHILDREN	CENTRAL PARK SCHOOL FOR CHILDREN	
QUALITY EDUCATION ACADEMY	QUALITY EDUCATION ACADEMY	
GREENSBORO ACADEMY	TRIAD MATH AND SCIENCE ACADEMY	
TRIAD MATH AND SCIENCE ACADEMY	PINE LAKE PREPARATORY	
PINE LAKE PREPARATORY	SUCCESS CHARTER SCHOOL	
SUCCESS CHARTER SCHOOL	SUMMIT CHARTER	
SUMMIT CHARTER	COMMUNITY SCHOOL OF DAVIDSON	
COMMUNITY SCHOOL OF DAVIDSON	SOCRATES ACADEMY	
SOCRATES ACADEMY	CAPE FEAR CENTER FOR INQUIRY	
SUGAR CREEK CHARTER	GASTON COLLEGE PREPARATORY	
CAPE FEAR CENTER FOR INQUIRY	MOUNTAIN DISCOVERY CHARTER SCHOOL	
GASTON COLLEGE PREPARATORY	HENDERSON COLLEGIATE	
MOUNTAIN DISCOVERY CHARTER SCHOOL	CASA ESPERANZA MONTESSORI	
UNION ACADEMY CHARTER SCHOOL	ENDEAVOR CHARTER	
HENDERSON COLLEGIATE	MAGELLAN CHARTER	
CASA ESPERANZA MONTESSORI	TORCHLIGHT ACADEMY	
ENDEAVOR CHARTER		
MAGELLAN CHARTER		
STERLING MONTESSORI ACADEMY		
TORCHLIGHT ACADEMY		

Table A.2: Effective

0.0	0.1	0.5
CHARTER DAY SCHOOL	CHARTER DAY SCHOOL	CHATHAM CHARTER
CHATHAM CHARTER	CHATHAM CHARTER	HEALTHY START ACADEMY
COLUMBUS CHARTER SCHOOL	COLUMBUS CHARTER SCHOOL	AMERICAN RENAISSANCE SCHOOL
HEALTHY START ACADEMY	HEALTHY START ACADEMY	CROSSROADS CHARTER HIGH
VOYAGER ACADEMY	VOYAGER ACADEMY	ARAPAHOE CHARTER SCHOOL
FORSYTH ACADEMY	CROSSROADS CHARTER HIGH	BETHANY COMMUNITY MIDDLE
AMERICAN RENAISSANCE SCHOOL	METROLINA REGIONAL SCHOLARS ACADEMY	LAKE LURE CLASSICAL ACADEMY
CROSSROADS CHARTER HIGH	ARAPAHOE CHARTER SCHOOL	MILLENNIUM CHARTER ACADEMY
METROLINA REGIONAL SCHOLARS ACADEMY	CIS ACADEMY	DILLARD ACADEMY
ARAPAHOE CHARTER SCHOOL	BETHANY COMMUNITY MIDDLE	BRIDGES CHARTER SCHOOL
CIS ACADEMY	MILLENNIUM CHARTER ACADEMY	
BETHANY COMMUNITY MIDDLE	VANCE CHARTER SCHOOL	
LAKE LURE CLASSICAL ACADEMY	FRANKLIN ACADEMY	
MILLENNIUM CHARTER ACADEMY	PREEMINENT CHARTER SCHOOL	
VANCE CHARTER SCHOOL	DILLARD ACADEMY	
FRANKLIN ACADEMY	BRIDGES CHARTER SCHOOL	
PREEMINENT CHARTER SCHOOL		
RALEIGH CHARTER HIGH SCHOOL		
DILLARD ACADEMY		
BRIDGES CHARTER SCHOOL		

Table A.3: Inefficient

0.0	0.1	0.5
THE HAWBRIDGE SCHOOL	THE HAWBRIDGE SCHOOL	THE HAWBRIDGE SCHOOL
ARTSPACE CHARTER	FRANCINE DELANY NEW SCHOOL	MAUREEN JOY CHARTER
FRANCINE DELANY NEW SCHOOL	THE NEW DIMENSIONS SCHOOL	GUILFORD PREPARATORY ACADEMY
THE NEW DIMENSIONS SCHOOL	TILLER SCHOOL	CHARLOTTE SECONDARY SCHOOL
TILLER SCHOOL	MAUREEN JOY CHARTER	KIPP: CHARLOTTE
MAUREEN JOY CHARTER	GUILFORD PREPARATORY ACADEMY	ORANGE CHARTER
GUILFORD PREPARATORY ACADEMY	NEUSE CHARTER SCHOOL	QUEST ACADEMY
NEUSE CHARTER SCHOOL	CHARLOTTE SECONDARY SCHOOL	SOUTHERN WAKE ACADEMY
CHARLOTTE SECONDARY SCHOOL	KIPP: CHARLOTTE	
KIPP: CHARLOTTE	ROCKY MOUNT PREPARATORY	
ROCKY MOUNT PREPARATORY	ORANGE CHARTER	
ORANGE CHARTER	THOMAS JEFFERSON CLASSICAL ACADEMY	
THOMAS JEFFERSON CLASSICAL ACADEMY	EXPLORIS MIDDLE SCHOOL	
EAST WAKE ACADEMY	HOPE ELEMENTARY CHARTER SCHOOL	
EXPLORIS MIDDLE SCHOOL	QUEST ACADEMY	
HOPE ELEMENTARY CHARTER SCHOOL	SOUTHERN WAKE ACADEMY	
QUEST ACADEMY	HALIWA-SAPONI TRIBAL SCHOOL	
SOUTHERN WAKE ACADEMY	TWO RIVERS COMMUNITY SCHOOL	
HALIWA-SAPONI TRIBAL SCHOOL		
TWO RIVERS COMMUNITY SCHOOL		

Table A.4: Ineffective

0.0	0.1	0.5
CROSSNORE ACADEMY	CROSSNORE ACADEMY	THE STEAM ACADEMY OF WINSTON SALEM
THE LEARNING CENTER	THE LEARNING CENTER	CROSSCREEK CHARTER SCHOOL
CARTER COMMUNITY CHARTER	CARTER COMMUNITY CHARTER	LAKE NORMAN CHARTER
GLOBAL SCHOLARS ACADEMY	GLOBAL SCHOLARS ACADEMY	WILMINGTON PREPARATORY ACADEMY
KESTREL HEIGHTS SCHOOL	RESEARCH TRIANGLE HIGH SCHOOL	BREVARD ACADEMY
RESEARCH TRIANGLE HIGH SCHOOL	CARTER G WOODSON SCHOOL	
CARTER G WOODSON SCHOOL	ARTS BASED SCHOOL	
ARTS BASED SCHOOL	CROSSCREEK CHARTER SCHOOL	
THE STEAM ACADEMY OF WINSTON SALEM	PIEDMONT COMMUNITY CHARTER	
CROSSCREEK CHARTER SCHOOL	PHOENIX ACADEMY INC	
PIEDMONT COMMUNITY CHARTER	THE MOUNTAIN COMMUNITY SCH	
PHOENIX ACADEMY INC	KINSTON CHARTER ACADEMY	
THE MOUNTAIN COMMUNITY SCH	CHILDREN'S VILLAGE ACADEMY	
KINSTON CHARTER ACADEMY	LINCOLN CHARTER SCHOOL	
CHILDREN'S VILLAGE ACADEMY	COMMUNITY CHARTER SCHOOL	
LINCOLN CHARTER SCHOOL	KENNEDY CHARTER	
COMMUNITY CHARTER SCHOOL	QUEENS GRANT COMMUNITY SCHOOL	
KENNEDY CHARTER	SANDHILLS THEATRE ARTS RENAISS	
LAKE NORMAN CHARTER	THE ACADEMY OF MOORE COUNTY	
QUEENS GRANT COMMUNITY SCHOOL	WILMINGTON PREPARATORY ACADEMY	
SANDHILLS THEATRE ARTS RENAISS	PACE ACADEMY	
THE ACADEMY OF MOORE COUNTY	BREVARD ACADEMY	
WILMINGTON PREPARATORY ACADEMY	SALLIE B HOWARD SCHOOL	
PACE ACADEMY		
GRAY STONE DAY SCHOOL		
BREVARD ACADEMY		
SALLIE B HOWARD SCHOOL		

REFERENCES

Abdulkadiroğlu, A., Angrist, J. D., Dynarski, S. M., Kane, T. J., & Pathak, P. A. (2011). Accountability and Flexibility in Public Schools: Evidence from Boston's Charters and Pilots. *The Quarterly Journal of Economics*, 126(2), 699–748. https://doi.org/10.1093/qje/qjr017

Alexander, K. L., Entwisle, D. R., & Bedinger, S. D. (1994). When expectations work: Race and socioeconomic differences in school performance. *Social Psychology Quarterly*, 283-299.

Alspaugh, J. W. (1994). The relationship between school size, student teacher ratio and school efficiency. *Education*, *114*(4), 593-602.

Anderson, D. M. (1996). Stretching the tax dollar: Increasing efficiency in urban and rural schools. *Where Does the Money Go?* 156-177.

Almeida, T. A. (2004). Refocusing school finance litigation on at-risk children: Leandro v. State of North Carolina. *Yale Law & Policy Review*, 22(2), 525-569.

Bali, V. A., & Alvarez, R. M. (2004). The race gap in student achievement scores: Longitudinal evidence from a racially diverse school district. *Policy Studies Journal*, 32(3), 393-415.

Bettinger, E. P. (2005). The effect of charter schools on charter students and public schools. *Economics of Education Review*, 24(2), 133–147. https://doi.org/10.1016/j.econedurev.2004.04.009

Bifulco, R., & Bretschneider, S. (2001). Estimating school efficiency: A comparison of methods using simulated data. *Economics of Education Review*, 20(5), 417–429. https://doi.org/10.1016/S0272-7757(00)00025-X

Bifulco, R., & Ladd, H. F. (2006). The Impacts of Charter Schools on Student Achievement: Evidence from North Carolina. *Education Finance and Policy*, 1(1), 50–90. https://doi.org/10.1162/edfp.2006.1.1.50

Bifulco, R., & Bulkley, K. (2007). Charter schools. *Handbook of Research in Education Finance and Policy*, 425-446.

Callahan, Raymond E. (1962). *Education and the Cult of Efficiency: A Study of the Social Forces that have Shaped the Administration of the Public School*. Chicago London: The University of Chicago Press.

Campbell, D.T. and Stanley, J.C. (1963) Experimental and Quasi-Experimental Designs

for Research on Teaching, *Handbook of Research on Teaching*. Chicago: Rand McNally & Company

Carpenter II, D. M., & Noller, S. L. (2010). Measuring charter school efficiency: An early appraisal. *Journal of Education Finance*, 35(4), 397-415.

Chapman, B., & Brown, S. R. (2014). Success Academy Charter Schools Admissions Rate is Only 20%, Lower Than NYU. New York Daily News.

Charter Schools 101. (2015). Retrieved January 9, 2017, from http://www.nea.org//home/60831.htm

Choy, S. P. (1997). Public and Private Schools: How Do They Differ? *Findings from. US Government Printing Office*, Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328.

Chubb, J. E., & Hanushek, E. A. (1990). *Reforming Educational Reform. Setting National Priorities*: Policy for the nineties, 213-248.

Clark, M. A., Gleason, P. M., Tuttle, C. C., & Silverberg, M. K. (2015). Do Charter Schools Improve Student Achievement? *Educational Evaluation and Policy Analysis*, 37(4), 419–436. https://doi.org/10.3102/0162373714558292

Cobb, Casey D. and Glass, Gene V. (1999). Ethnic Segregation in Arizona Charter Schools. *Education Policy Analysis Archives* (7)1.

Coleman, J. (1981). Public Schools and Private Schools (p. 298). University of Chicago. Retrieved from: http://files.eric.ed.gov/fulltext/ED197503.pdf

Coons, J. (2008). Private Wealth and Public Schools. *Stanford Journal of Civil Rights & Civil Liberties*, 245. Retrieved from http://scholarship.law.berkeley.edu/facpubs/1118

Cremata, E., Davis, D., Dickey, K., Lawyer, K., Negassi, Y., Raymond, M., & Woodworth, J. (2013). National Charter School Study (p. 104). CREDO: Stanford University.

Crew, Robert E, and Anderson, Mary R. (2003). Accountability and Performance in Charter Schools in Florida: A theory Based Evaluation. *American Journal of Evaluation* 24:189-212.

Cubberley, E. P. (1905). School funds and their apportionment (No. 2). Teachers College, Columbia University.

Duncombe, W., & Yinger, J. (2008). Measurement of Cost Differentials. *Handbook of Research in Education Finance and Policy,* 238-256.

Durham, D. L. 210 S. D. B. 90362, & Office 613-7006, N. 27708. (n.d.). Leandro v. State Duke University School of Law. Retrieved October 29, 2016, from https://law.duke.edu/childedlaw/schooldiscipline/attorneys/casesummaries/leandrov state/

Frankenberg, Erica, and Lee, Chungmei. (2003). Charter Schools and Race: A Lost Opportunity for Integrated Education. *Educational Policy Analysis Archives* 11(32).

Friedman, M. (1966). A Free Market in Education. *The Public Interest*, 0(3), 107. Retrieved from http://search.proquest.com.libproxy.lib.unc.edu/docview/1298125242/citation

Friedman, T. L. (2008). *Hot, flat, and crowded: Why we need a green revolution--and how it can renew America*. Macmillan.

Fryer, R. G. (2014). Injecting Charter School Best Practices into Traditional Public Schools: Evidence from Field Experiments. *The Quarterly Journal of Economics*, 129(3), 1355–1407. https://doi.org/10.1093/qje/qju011

Fulton, M. (1993). School Financial Litigation: A Historical Summary. Retrieved from https://eric.ed.gov/?id=ED357443

Gardner, D. P. (1983). A nation at risk. Washington, DC: The National Commission on Excellence in Education, US Department of Education.

Goldstein, S. R. (1972). Interdistrict inequalities in school financing: a critical analysis of Serrano v. Priest and its progeny. *University of Pennsylvania Law Review*, 120(3), 504-544.

Greenwald, R., Hedges, L. V., & Laine, R. D. (1996). The effect of school resources on student achievement. *Review of Educational Research*, 66(3), 361-396.

Gronberg, T. J., Jansen, D. W., & Taylor, L. L. (2012). The relative efficiency of charter schools: A cost frontier approach. *Economics of Education Review*, 31(2), 302-317.

Grosskopf, S., Hayes, K. J., & Taylor, L. L. (2009). The relative efficiency of charter schools. *Annals of Public and Cooperative Economics*, 80(1), 67-87.

Guthrie, J., and Peng, A. The Phony Funding Crisis. (2009, November 5). Retrieved October 12, 2016, fromhttp://educationnext.org/the-phony-funding-crisis/

Hanushek, E. A. (1986). The Economics of Schooling: Production and Efficiency in Public Schools. *Journal of Economic Literature*, 24(3), 1141–1177. Retrieved from http://www.jstor.org/stable/2725865

Hanushek, E. A. (1996). School resources and student performance. Does money matter?

The effect of school resources on student achievement and adult success, 43-73.

Hanushek, E. A., (2007). Milton Friedman's Unfinished Business. Retrieved January 9, 2017, from http://hanushek.stanford.edu/publications/milton-friedman%E2%80%99s-unfinished-business

Harvey, D. (2007). A brief history of neoliberalism. Oxford University Press, USA.

Hess, F. M., & Osberg, E. (2010). Stretching the School Dollar: How Schools and Districts Can Save Money While Serving Students Best. Educational Innovations. Harvard Education Press. 8 Story Street First Floor, Cambridge, MA 02138.

Herzog, M. J. R., & Pittman, R. B. (1995). Home, family, and community: Ingredients in the rural education equation.

Hickrod, G. A. (1990). The Biggest Bang for the Buck: A Further Investigation of Economic Efficiency in the Public Schools of Illinois. MacArthur/Spencer Series Number 16.

Hickrod, G. A., & Genge, F. C. (1994). The "Quadriformi" and the Curriculum: An Approach to Economic Efficiency in the Public Schools. *Journal of Education Finance*, 20(2), 209-221.

Hickrod, G. A., Liu, C. C., Arnold, R., Chaudhari, R., Frank, L., & Franklin, D. (1989). *The biggest bang for the buck: An initial report on technical economic efficiency in Illinois K-12 schools with a comment on "Rose v. the Council."* Normal, IL: Center for the Study of Educational *Finance*.

Houck, E. A., Rolle, R. A., & He, J. (2010). Examining School District Efficiency in Georgia. *Journal of Education Finance*, 35(4), 331-357. doi:10.1353/jef.0.0022

Howley, C. B. (2002). Grade-span configurations. *School Administrator*, *59*(3), 24-29.

Hoxby, C. M. (1994). Does Competition Among Public Schools Benefit Students and Taxpayers? (Working Paper No. 4979). National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w4979

Hoxby, C. M. (2003). School choice and school productivity. Could school choice be a tide that lifts all boats? *The economics of school choice* (pp. 287-342). University of Chicago Press.

Hursh, D. (2007). Assessing "No Child Left Behind" and the Rise of Neoliberal Education Policies. *American Educational Research Journal*, 44(3), 493–518. Retrieved from http://www.jstor.org/stable/30069426

Kahlenberg, R. D., & Potter, H. (2014, August 30). The Original Charter School

Vision. The New York Times. Retrieved from https://www.nytimes.com/2014/08/31/opinion/sunday/albert-shanker-the-original-charter-school-visionary.html

Khrais, R. (2014). 26 New Charter Schools Will Be Biggest Expansion in NC Program's History. Retrieved March 1, 2017, from http://wunc.org/post/26-new-charter-schools-will-be-biggest-expansion-nc-program-s-history

Lubienski, S. T., & Lubienski, C. (2006). School Sector and Academic Achievement: A Multilevel Analysis of NAEP Mathematics Data. *American Educational Research Journal*, 43(4), 651–698. https://doi.org/10.3102/00028312043004651

Lubienski, C., & Lubienski, S. (2006). Charter, private, public schools and academic achievement: New evidence from NAEP mathematics data.

Lubienski, C., Weitzel, P., & Lubienski, S. T. (2009). Is There a "Consensus" on School Choice and Achievement?: Advocacy Research and the Emerging Political Economy of Knowledge Production. *Educational Policy*, 23(1), 161–193. https://doi.org/10.1177/0895904808328532

Miller, C. (2002). Industrial Subjects: Education and Efficiency. *Taylored Citizenship: State Institutions and Subjectivity*, 99.

Mosteller, F. (1995). The Tennessee study of class size in the early school grades. *The future of children*, 113-127.

Nelson, F. H., Muir, E., & Drown, R. (2003). Financing Autonomy: The Impact of Mission and Scale in Charter School Finance. *The State Education Standard*, 4(3), 38-44.

No Child Left behind Charter School Guidelines. (2001) Title V, Part B, Non-Regulatory Guidance. Retrieved from: https://www2.ed.gov/policy/elsec/guid/cspguidance03.pdf North Carolina Department of Public Instruction. Charter School Membership by Region and State "csmembersregion15-16.pdf." (2014). Retrieved from http://www.dpi.state.nc.us/docs/fbs/resources/data/csmembersregion15-16.pdf

Olssen*, M., & Peters, M. A. (2005). Neoliberalism, higher education and the knowledge economy: From the free market to knowledge capitalism. *Journal of Education Policy*, 20(3), 313-345.

Okun, A. (1976). Equal rights but unequal incomes. New York Times Magazine, 102-3.

Oluwole, P. C. G. I., Bruce D. Baker, Joseph O. (n.d.). Having It Both Ways: How Charter Schools Try to Obtain Funding of Public Schools and the Autonomy of Private Schools | Emory University School of Law | Atlanta, GA. Retrieved March 2, 2017, from http://law.emory.edu/elj/content/volume-63/issue-2/articles/charter-schools-public-funding.html

Ortiz-Ospina, Este Esteban and Roser, Max. (2016) 'World Population Growth'. Published online at OurWorldInData.org. Retrieved from: https://ourworldindata.org/world-population-growth/

Picus, L. O., Goertz, M., & Odden, A. (2008). Intergovernmental aid formulas and case studies. *Handbook of Research in Education Finance and Policy*, 257-275.

Podgursky, M., & Ballou, D. (2001). Personnel Policy in Charter Schools.

Reeves, C. (2003). Implementing the No Child Left Behind act: Implications for rural schools and districts. Retrieved June, 14, 2011.

Rolle, R. A. (2004). Out with the old – in with the new: Thoughts on the future of educational productivity research. *Peabody Journal of Education*, 79 (3), 31 – 56.

Rolle, A., & Houck, E. A. (2004). Introduction to the Peabody Journal of Education's Special Issue on the Future of School Finance Research. *Peabody Journal of Education*, 79(3), 1-6.

Renzulli, L. A., & Evans, L. (2005). School Choice, Charter Schools, and White Flight. Social Problems, 52(3), 398–418. https://doi.org/10.1525/sp.2005.52.3.398

San Antonio Independent School District v. Rodriguez. (1972). Retrieved January 9, 2017, from https://www.law.cornell.edu/supremecourt/text/411/1

Senate bill proposes ending DPI control of charter school oversight. (2015, July 23). Retrieved March 2, 2017, from http://www.ncpolicywatch.com/2015/07/23/senate-bill-proposes-ending-dpi-control-of-charter-school-oversight/

Springer, M. G., Houck, E. A., & Guthrie, J. W. (2008). History and scholarship regarding United States education finance and policy. Handbook of research in education finance and policy, 3-22.

Staff. (2016). NC governor candidates on teacher pay, school spending, pre-K, other education issues. Retrieved March 8, 2017, from http://www.newsobserver.com/news/politics-government/election/article111364192.html

Standerfer, L. (2006). Before NCLB: The history of ESEA. *Principal Leadership*, 6(8), 26-27. Retrieved from http://libproxy.lib.unc.edu/login?url=http://search.proquest.com/docview/233341760?accountid=14244

State Board of Ed chair to charter advisory panel: "Not so fast." (2016, October 20).

Retrieved March 2, 2017, from http://www.ncpolicywatch.com/2016/10/20/state-board-ed-chair-charter-advisory-panel-no-fast/

State Supreme Court: Charter schools are unconstitutional. (2015, September 4). Retrieved March 2, 2017, from http://www.seattletimes.com/seattle-news/education/state-supreme-court-charter-schools-are-unconstitutional/

Stevens, C. A. (2007). Applying the modified quadriform to measure efficiency in Texas public schools. Texas A&M University. Retrieved from http://oaktrust.library.tamu.edu/handle/1969.1/49

Stuit, D., & Smith, T. M. (2010). Teacher Turnover in Charter Schools. Research Brief. National Center on School Choice, Vanderbilt University (NJ1).

Taylor, F. W. (2004). Scientific Management. Routledge.

Tractenberg, P. (1974). Robinson v. Cahill: The "Thorough and Efficient" Clause. *Law and Contemporary Problems*, 38(3), 312–332. Retrieved from http://scholarship.law.duke.edu/lcp/vol38/iss3/4

Weiher, G. R., & Tedin, K. L. (2002). Does choice lead to racially distinctive schools? Charter schools and household preferences. *Journal of Policy Analysis and Management*, 21(1), 79. doi:10.1002/pam.1041

Wells, Amy Stuart. (1998) Charter School Reform in California – Does it Meet Expectations? Phi Delta Kappan, 80:305-12.

Wise, A. E. (1968). Rich Schools, Poor Schools: The Promise of Equal Educational Opportunity.

Witte, K. D., & López-Torres, L. (2015). Efficiency in education: a review of literature and a way forward. *Journal of the Operational Research Society*. https://doi.org/10.1057/jors.2015.92

Zernike, K. (2016, December 12). How Trump's Education Nominee Bent Detroit to Her Will on Charter Schools. *The New York Times*. Retrieved from https://www.nytimes.com/2016/12/12/us/politics/betsy-devos-how-trumps-education-nominee-bent-detroit-to-her-will-on-charter-schools.html