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How Districts Allocate Educational Resources in Rhode Island

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HOW DISTRICTS ALLOCATE EDUCATIONAL RESOURCES IN RHODE ISLAND: THE RELATIONSHIP BETWEEN SPENDING AND STUDENT ACHIEVEMENT

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ABSTRACT

Considerable debate has taken place regarding the amount, adequacy, and effectiveness of funding public schools. At the macro level, research is mixed as to whether increased funding is associated with improved student performance. In some specific cases, such as increased funding for lower class size and early childhood education, spending on specific activities has shown to be effective.

This study examined whether spending categories are associated with academic performance. Spending allocations and student performance were examined at the school level for the school years 2004-05 through 2007-08. Spending data was obtained through the Rhode Island Department of Education In$ight financial system. Student performance on the New England Common Assessment Program was used. Two models were employed: Model 1 examined the aggregate figures for the four years of data regression with a robust estimator to examine the association of the spending categories and achievement accounting for poverty. Model 2 used multiple regression with a differencing model in an attempt to control for unobserved factors such as teacher quality.

The results of the differencing Model 2 were not conclusive. Model 1 showed that spending for direct classroom instruction was a significant predictor of student achievement. Poverty was also identified as significantly negatively associated with student performance. All other allocations were either negatively associated or not associated with student performance.

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CHAPTER 1

INTRODUCTION

The improvement of student academic performance has been in the forefront of national public policy since the publication of *A Nation at Risk* in 1983. Beginning under the Reagan presidency and followed by each administration since, the federal role in public education has expanded considerably, culminating in the No Child Left Behind Act of 2002. Improving educational outcomes through school reform is widely accepted by both political leaders and the general public and the level of resources needed to sustain improvement is a major topic of debate at the national, state and local level. Insufficient attention, however, has been directed to how financial resources are utilized and whether the current patterns of allocation are effectively improving student performance (Wong, 1999).

Per-pupil education expenditures have tripled in the United States during the three decades from 1960 to 1999 (Odden&Pincus, 2004). However, increased spending has not been associated with improved student achievement (Hanushek, 2004). These national trends have been mirrored in Rhode Island: Expenditures for public education in Rhode Island rose 6% from the years 2000-2006 while many of the highest spending districts are the lowest performing. Also, in 2008, spending in Rhode Island was $12,478 per pupil, ranking 7th nationally, while student achievement ranked 26thamong US states (*Education Week*, 2009).

Symptomatic of the mismatch between funding and achievement has been Rhode Island's historicalfailure to develop a coherent education funding model; Rhode Island

became the last state in the country to adopt a funding formula for state aid to education. In the spring of 2010, legislation was enacted to institute a statewide funding formula which includes: 1) a foundation model in which a basic floor of aid would be established for each student; 2) a poverty indicator which provides additional funds to meet the needs of students with low socioeconomic status (SES) and correlates to the supports needed by children with limited English skills; and3) the capacity to provide local revenue to provide equitable and adequate resources(Rhode Island Department of Education, 2010).

While Rhode Island's new funding formula addresses equity in providing more state aid to communities with limited capacity to raise local revenue, it does not address resource allocation within districts. Spending decisions are to be left at the local level without regard to how districts are currently utilizing their funds and whether existing practice is producing positive results in student achievement. Thus, there is no change to the allocation of educational expenditures to improve student learningunless the individual district performs this activity on its own initiative.

In summary, despite the cost and quality problems in American education which are mirrored in Rhode Island, existing research has not identified clear relationships between spending and performance and has not articulated the factors underlying variations in spending patterns across school districts.

Purpose of the Study

The purpose of this study was to examine to what extent resource allocations in Rhode Island schools are related to student performance. It was expected that the results of this study will provide state and local decision-makers with information and strategies

for improving the allocation of financial and non-financial resources to support greater student success.

The study employed two models. The first pooled data over the entire study period (2004-2008)and tested the association between resource use and student achievementwhile controlling for student socioeconomic status. The second model was longitudinal, testing the association between changes in resource use and changes in student achievement. By testing the association between changes in resource use and changes in student achievement, the second model would account for unmeasured school-level factors that remain constant across adjacent years.

Research Question 1: What is the relationship between spending on public education in Rhode Island and student achievement?

Research Question 2: What is the relationship between annual changes in spending on public education in Rhode Island and annual changes in student achievement?

Hypothesis 1:

Higher per-pupil spending on direct instruction at the school level is associated with higher student reading, math, and writing performance.

Hypothesis 2:

Higher per-pupil spending on instructional support, operations, leadership and other commitments at the school levelare not associated with higher student reading, math, and writing performance.

Hypothesis3:

School-level changes in per-pupil spending on direct instruction are associated with changes in student reading, math, and writing performance.

Hypothesis 4:

School-level changes in per-pupil spending on instructional support, operations, leadership and other commitments are not associated with changes in student reading, math, and writing performance.

CHAPTER 2

LITERATURE REVIEW

Theoretical Framework: Educational Production Function and Agency Theory

In a pluralistic, multi-ethnic society like the United States, the purpose of public education is a matter of considerable debate. As political and economic issues gain prominence, pressure to "reform" education often follows. The tension regarding the purpose of public education reflects the competing emphases on the principles of liberty, equality and efficiency (Guthrie, 2003). Public policy emerges to address an identified or perceived need, and the targets of the policy, as well as those who share the burdens of its impact and cost is of particular concern (Schneider & Ingram, 1993).

For many years, education was assessed on an "inputs" basis. Schools were rated by criteria such as volumes in the library, number of electives offered and the condition of the physical plants. In Rhode Island, the Basic Education Program (BEP) was an effort to establish minimum input standards for each district, the assumption being that by providing a minimum level of program, students would have the opportunity to meet their academic expectations (Galston, 2005; Rhode Island Department of Education, 1989).

Following the publication of *A Nation at Risk*, concern over the academic performance of American schools became a prominent national issue as attention shifted to the outputs of the system. In this context, an argument was made that school reform must be viewed from an economic perspective. Hanushek (1994) maintained that little systemic relationship has been found between resources and student performance. He recommended that schools evaluate educational programs on a cost-benefit basis,

improve performance by providing incentives to teachers (merit pay) and parents (school choice, privatization of educational services), and allow for continuous adaptation and re-structuring of existing institutions (Hanushek, 1994).

Production Theory

Mainstream economic theory assumes that firms seek to find the most efficient use of inputs to maximize profits. Production theory asks what combination of inputs, as factors of production, will generate the quantity of output that yields maximum profit. A process is inefficient if a different combination of inputs could produce a greater quantity of goods or services. Economists use a mathematical equation model known as a production function to study production empirically. The production function model's output is a function of various levels of inputs (Mankiw, 2003).

Production theory holds that resources allocated toward activities that are more proximally related to student outcomes will result in better student performance. This implies that resources dedicated to direct instruction will improve student outcomes more than resources dedicated to activities without a strong relationship with student outcomes.

The production function in education examines the output of a school system, measured in standardized test scores, graduation rates, and years of schooling, for example, against the input variables, such as expenditures on classroom instruction, operations, libraries, extracurricular programs, or other activities (Monk, 1990; Hanushek, 1979). Education production models attempt to predict the factors that maximize output. As a result of the application of economic principles to education policy, Hanushek asserts that "Reform will come more assuredly from an improved

decision process that focuses attention on student performance than from further attempts to overwhelm the problems of schools with resources" (Hanushek, 1994, p 151).

The production function is useful tool for economic analysis but has limits that must be taken into consideration. The narrow use of test scores as the sole output of an educational system overlooks the diverse functions and responsibility of schools. For example, the federal government has directed most of its educational spending to counter the inequity that arises from class, language, race, and disability. Funding for education is critical to produce the societal goal of liberty and equality by providing educational opportunity, regardless of socioeconomic status (Wong, 1999). In addition, a strictly economic analysis of the production function ignores the complicated political forces that operate in school systems.

The production function also assumes that educational organizations work in concert to achieve like goals in student achievement (Odden&Picus, 2004). However, contemporary implementation study recognizes the complexity of putting a policy into practice. The goals, targets and tools of a particular policy interact with the people who are affected and the culture of the local setting where the policy is enacted. Cross-system and organizational relationships affect the production function in terms of policy implementation. School systems are constrained by sources and amounts of revenue, the misalignment of mission due to the agency problem, employee contracts, state and federal regulations, and other aspects of production. Unlike private firms, educational institutions do not control their student and family inputs. Political realities must be considered along with an economic approach to the education production function thatcan identify how resources are allocated and their relationship to student achievement

(Loeb & McEwan, 2006). The relationship between spending and outcomes can be examined through agency theory (Honing, 2006).

A production formula applied in a manufacturing context may produce more definitive results then when used in an educational setting, given the fact that public educational institutions have multiple goals beyond achievement tests as outputs, and have far more variables associated with the inputs, most notably the students. Nonetheless, economic production theory has a place in the financial analysis of school districts to examine if resources are allocated effectively.

Agency Theory

There are two key barriers to using an education production model to improve educational outcomes. First, the relationship between education inputs and outputs remains poorly understood. Second, assuming perfect knowledge of the production function and the interest of a district to put the production function into place, the optimal allocation of resources may not be employed. This is a result of both the political realities of school systems and the self-interested behavior of actors in the system.

The principal-agent problem arises when a principal compensates an agent for performing certain acts that are useful to the principal and costly to the agent, and where there are elements of the performance that are costly to observe.The misalignment of interests among administrators and management (the district) and agents (teachers) is an example of an agency problem (Pratt &Zeckhauser, 1985; Ross, 1973).Agency theory is the study of the behavior of principals and agents in the presence of agency problems. In the context of this study, teachers and administrators likely have numerous interests that differ from those of the district, including personal benefits such as pay, job security and

working conditions. Given the strength of unions in public education, many of these preferences are institutionalized, at the expense of efficient allocation of resources. However, as shown by differences in teacher contracts, union strength varies substantially across districts, resulting in variations in the extent to which union preferences are institutionalized.

In a business illustration, the principal could be the factory owner, and two types of agents are the sales staff and production workers. The owner (principal) wishes to maximize profits, and may do so in more than one way: s/he may attempt to align the agents with his goals by profit sharing, increasing production incentives, sales bonuses, or incentives for meeting production targets; another owner may attempt to maximize profits by keeping expenses low. S/he may not share information with the workers and thus increase the risk of creating an agency problem. The workers may feel far removed from the goals of the company and may form a union to protect their working conditions and job security.

When applied to public schools, agency theory becomes far more complex. The workers in a school system such as central administrators, building principals, teachers, classroom aides, clerks, and custodians, filter policy and district goals through the lens of their own experience. These groups generally promote and protect their vested interests in terms of their wages, working conditions and institutional power structure. Goals and policies that are viewed as inconsistent with their interests are likely to face opposition (Malen, 2006).

Production Function and Agency Theory in Rhode Island Public Education

The multiple layers of principal-agent relationshipsinfluence the allocation of resources for public education in Rhode Island. In terms of state aid for education, the State, through the Department of Education (RIDE), is the principal and the districts are agents in terms of providing state assessment data, meeting grade level and grade span curriculum expectations, and meeting graduation requirements and other responsibilities under state laws and regulations. The districts, through their local school committees, are principals whose respective agents are administrators, teachers and non-instructional staff, whose primary interest may not be directly related to student achievement. Schools provide a service that cannot be measured by their profit or loss. Instead, output in the form of assessment results, graduation rates, community support, and school climate is multidimensional and difficult to measure. What a school produces in terms of increased test scores or graduation rates is the result of the contributions of numerous individuals over time (Loeb & McEwan, 2006).

In addition to principal/agent relationships, communities are influenced by political, fiscal and demographic realities in the allocation of resources. For example, districts with relatively small school population and high property value per pupil have ample resources and can meet local need by providing jobs with security and benefits to local residents (Galston, 2005). In urban districts, which receive a higher proportion of state aid relative to the local contribution in order to serve a higher percentage of low-income students, teacher contracts often provide generous benefits to agents/teachers whose primary goal may be higher wages and post- retirement benefits (Grubb et al, 2006).

Lack of community resources and small amounts of state aid may limit per-pupil spending. The local political decision to dedicate more local resources to municipal services may impact educational spending as well. This situation requires a school district to prioritize spending to direct instruction (basic facilities, curriculum offerings and teachers) as the school budget hovers at a break-even threshold. Once the threshold is met, however, districts tend to spend on more peripheral purposes to meet community needs: employing more local residents (maintenance workers, classroom aides, crossing guards), providing more student support (guidance, remedial and gifted teachers), adding enrichment programs (after school activities, sports, field trips), and enhancing facilities (building renovations, vehicle purchases, technology upgrades). The spending beyond the threshold may meet community needs and provide desired programs, but may not be directly related to academic achievement (Picus&Fazal, 1995).

"The politics of resource allocation over the last thirty years can be characterized as a process of layering, adding more social responsibilities and bureaucratic guidelines to the school's core instructional functions" (Wong, 1999, p15). With the passage of time, layers of decisions become institutionalized and rarely change. This is true at all levels of government. At the federal level, rules on compensatory funding restrict the local district's ability to utilize funds creatively; state laws passed years before continue to dictate school decisions in a different environment, and locally negotiated teacher contracts restrict schools' ability to assign staff where they can best meet student needs (Wong, 1999).

How districts allocate resources may be examined by comparing the per-pupil expenditures allocated to direct instruction to other expenditures. A systematic

examination of allocation processes can provide the knowledge base for school reformers to redesign decision rules to improve student performance (Wong, 1999).

Factors Affecting Achievement

The educational production function must take into account the variations that occur between the inputs to the system. The different backgrounds and abilities that the children bring to school determine whether teachers can begin their instruction at a remedial or accelerated pace. The socio-economic status of children has been shown to be strongly related to predicting student achievement, as has class size, teacher quality, and other factors.

Student Socio-Economic Status

Beginning with the Coleman Report (1966), socio-economic status (SES) at the student level has been found to be one of the strongest correlates of academic performance. The correlates at the school level are even stronger. Family SES sets the stage for students' academic performance both by directly providing resources at home and by indirectly providing the social capital that is needed for school success (Coleman, 1988). As a result of current educational and social policies, students who are at risk because of family SES are more likely to end up in schools with limited financial resources (Reynolds & Walberg, 1992,Sirin, 2005). Low SES schools have important differences from their affluent counterparts in terms of quality of instruction, materials, teacher experience, and class size (Wenglinsky, 1998). In addition to the quality of instruction, family SES is related to the quality of relationships between school personnel and parents (Watkins, 1997). Thus, SES not only reflects the effect of resources at home,

but is also associated with social capital and its effect on academic achievement (Sirin, 2005).

Student poverty is negatively correlated with student outcomes, and usually significantly so.Student poverty is also significantly and negatively correlatedwith the qualifications of teachers; that is, the less socially advantaged thestudents, the less likely teachers are to hold full certification and a degree intheir field and the more likely they are to have entered teaching withoutcertification (Darling-Hammons, 1999).

Despite these limitations, there have been interventions that have improved the educational achievement of those who might otherwise fail in school because of their family background. For example, small school and class size (Finn & Achilles, 1990; Glass & Smith, 1989; Grissmer et al., 1998; Krueger, 1998), early childhood education, federal programs such as Title 1 and Head Start, after-school programs and summer school sessions (Entwisle& Alexander, 1994), and qualified school personnel (Wang, 1998), have all been found to be important factors in reducing the achievement gap between children of the "haves" and the "have-nots." Future educational and social programs have the potential to provide more support for these and other innovative programs that can lift the educational achievement of those who are at risk for school failure due to family SES. Without such support, the current system is likely to produce an intergenerational cycle of school failure because of family SES (Sirin, 2005).

Data on free and reduced-price lunches are consistently used as a proxy for SES because of their link to the government's poverty guidelines, are available for every student, they are nonintrusive, theyare simple (eligible, not eligible), and they can be obtained relatively cheaply because information are taken directly from school records.

These characteristics help to explain the continued popularity of this variable as a measure of SES (Harwell &LeBeau, 2010). Harwell &LeBeau caution that use of free and reduced lunch data has its limitations: eligibility is a poor measure of a student's access to economic resources; participation rates decline with increases in grade level; status is theoretically available for every student, however, failure to respond to the program results in a classification of non-free and reduced, and a resulting inappropriate evaluation of SES.

Multiple linear regression procedures produced strong evidence that the socioeconomic status of the district was the predominant predictor of student performance on the 2003 Washington Assessment of Student Learning Reading and Mathematics subtests for 4th and 7th graders. Positive correlations that emerged between actual levy percentages and student achievement provided evidence that through equitable, adequate, and appropriate public school fiscal practices, Washington school districts that are small and rural have the potential to overcome a portion of the strong and negative association between poverty and student outcomes (Diaz, V., 2008)

Although at nine months of age there are no detectable cognitive differences between black and white babies, differences emerge as early as age two, and by the time black childrenenter kindergarten they are lagging behind whites by 0.64 standard deviations in math and 0.40 in reading (Fryer & Levitt, 2004). On every subject at every grade level, there are large achievement differences between black children and white children that continue to grow as they progress through school. Even accounting for a host of background factors, the achievement gap remains large and statistically significant (Fryer, 2010, Neal, 2006).

Fryer and Levitt (2006) take a pessimistic view of educational interventions to address the gaps in student SES. They state that the attempts to close the achievement gap such as early childhood interventions Head Start, Nurse-Family Partnership, and the Abecedarian Project, boost kindergarten readiness, but the effects on achievement often fade once children enter school (Krueger & Whitmore, 2001; Anderson, 2008). More aggressive strategies that place disadvantaged students in better schools through busing (Angrist& Lang, 2004) and school choice plans (Rouse, 1998; Krueger & Zhu, 2002; Cullen et al., 2005; Hastings et al., 2006), have also left the racial achievement gap essentially unchanged.

The lack of progress has fed into a long-standing debate among scholars, policy-makers, and practitioners as to whether schools alone can close the achievement gap or whether the issues children bring to school are too much for even the best educators to overcome. Proponents of the school-centered approach refer to anecdotes of excellence in particular schools or examples of other countries where poor children in superior schools outperform average Americans (Chenoweth, 2007). Advocates of the community-focused approach argue that teachers and school administrators are dealing with issues that originate outside the classroom, citing research that shows racial and socioeconomic achievement gaps are formed before children ever enter school (Fryer & Levitt, 2004; 2006), and that one-third to one-half of the gap can be explained by family-environment indicators (Phillips et al., 1998; Fryer & Levitt, 2004). In this scenario, combating poverty and having more constructive out-of-school time may lead to better and more-focused instruction in school. Coleman et al. (1966), in their report on equality

of educational opportunity, argue that schools alone cannot treat the problem of chronic underachievement in urban schools.

Class Size Reduction

Under specific conditions, class size reduction has been associated with improved student performance. In the randomized Tennessee Student/Teacher Achievement Ratio (STAR) experiment, the state of Tennessee tested the effect of smaller class size on student achievement. This study ran for four years and was implemented for a cohort of kindergartens beginning in 1985. The study continued until the students completed third grade, and included over 11,600 students. Results from the experiment showed a strong and lasting effect of smaller class sizes. The presence of classroom aides was not significant. Students in smaller classes outperformed their counterparts in large classes, and the more years they stayed in reduced sized classes, the longer-lasting were the benefits. In addition, the effect sizes were significantly greater for minority students in the smaller classes, based on reading and mathematics performance (Finn & Achilles, 1990; Grissmer et al., 1998; Krueger, 1998).

Findings in Wisconsin's Student Achievement Guarantee in Education (SAGE) are consistent with the STAR experiment.The Student Achievement Guarantee in Education (SAGE) was designed to improve the academic achievement of children living in poverty by: 1) reducing class size to fifteen students in grades one and two; 2) staffing before and after school programs; and 3) conducting extensive staff development. A quasi-experiment was conducted by examining the performance of students in the SAGE schools with a comparable population in a non-SAGE control group. The results

demonstrated that participation in all the components of the SAGE program was a significant predictor of success in later grades (Molnar, Smith, Zahorik, Palmer, Halbach&Ehrle, 2000).

Massive class size reduction programs must calculate the ability of facilities to provide sufficient classroom space and the availability of qualified teachers necessary to meet the increased demand. When California undertook a similar, state-wide initiative to reduce class sizes, there were immediate problems of teacher shortages, insufficient classroom space, and higher costs. The California class-size reduction program (CSR) used an infusion of state funds to reduce class sizes in grades K-3 from twenty-eight to twenty students. Similar to the STAR program, the California CSR found smaller but statistically significant differences in reading, math and language between students in smaller classes and students in larger classes. Because of the resulting facilities issues and shortage of teachers that affected less affluent districts, Bohrnstedt and Stecher (1999) observed that rather than improve greater opportunity for learning, the California initiative increased the inequities between schools that served the wealthy and those that served lower-income students.

It is important to note that pupil-teacher ratios and class size are not necessarily the same.Data on pupil-teacher ratios reflect the total number of teachers and students at a given time, but not their utilization. For example, a district may have only two teachers, one who spends all day in class with the students and the other who is department head, and spends all day evaluating the lesson plans of the classroom teacher. In this case, the pupil-teacher ratio is half that of the class size experienced by the students. If teachers are required to meet fewer classes during the day than the number of classes that each student

takes, the pupil-teacher ratio will be less than the average class size. Some teachers are also assigned to various duties outside the regular classroom, such as lunch, study hall or corridor supervision. Thus typical class sizes observed in schools tend to be larger than measured pupil-teacher ratios. Class size is defined in teacher contracts in terms of fairness as opposed to student achievement (Hanushek, 1999).

In conclusion, class size reduction, under specific circumstances, is a predictor of student achievement.

Teacher Quality

The salaries and benefits for teachers account for the largest portion of a school budget and thus are the main component of the production function. It is implicit that teacher quality and effective practice would be associated with student achievement.

There is evidence that the strategies employed by teachers as well as their education source and levels have an influence on student performance (Haycock, 1998; Rivkin, et. al, 2005), Students learn more from teachers who have graduated from higher-rated institutions, and in the case of mathematics, students learn more from teachers with certification in mathematics and degrees in and courses related to mathematics (Wayne &Youngs, 2003). Studies linking teacher scores on tests of academic ability to student achievement have led some to believe that general academic ability and verbal skills are measureable predictors of teacher quality (Ferguson & Ladd, 1996; Hanushek, 1996). When studies have examined teacher knowledge of both subject matter and how to teach, they found that knowledge of methodology also had a strong relationship to student achievement (Darling-Hammond & Sykes, 2003; Rivkin, Hanushek&Kain, 2005;

Wenglinsky, 2002).Characteristics such as education level (percentage of teachers with master'sdegrees), show a positive but less strong relationships with education outcomes (Darling-Hammond, 1999).

Research on the impact of teacher quality on student achievement revealed that students' exposure to successive years of poorly qualified teachers during the formative educational stages, impacts long-term achievement. Yet, the research also shows that students from low-income and minority communities are often served by the least qualified teachers (Ferguson, 1998; Sanders & Rivers, and the Education Trust, 1998).

Partial correlations confirm a strong, significant relationship of teacher quality variables to student achievement, even after controlling for student poverty and for student language background. Darling-Hammond (1999) identified teacher certification as a predictor of student achievement. She found the strongest, consistently negative predictors of student achievement, also significant in almost all cases, were the proportions of new teachers who are uncertified (Darling-Hammond, 1999, Darling-Hammond, L., & Sykes, G.2003). Teacher characteristics of verbal ability, exam scores and experience studied in production function research, bear a stronger and more consistent relationship with pupil performance on achievement tests, than do other characteristics in terms of teacher ability (Jefferson, 2005).

Leadership studies have had the same mixed results as thosewhichexamined teacher quality. Waters, Marzano and McNulty (2003) identified twenty-one leadership responsibilities associated with improved student performance in their meta-analysis.

They acknowledge, however, that poor leadership is associated with negative student performance.

Other Influences on Achievement

Research has shown that numerous factors influence student achievement, many of which are not related to financial intervention and are outside the production function.

A number of researchers have identified parental expectations as significant to student performance in school and are critical to student academic achievement. High expectations from parents are generally associated with higher levels of educational attainment. Effective parenting practices associated with high levels of academic achievement include expectations that children earn high numerical grades on schoolwork. In addition, the research suggests that child rearing beliefs, provisions for academically enriching home environments, and standards of acceptable behavior in and out of school are equally important to academic achievement (Jencks and Phillips, 1998; Okagaki&Frensch, 1998, Wong, 1990).

Parental education and social economic status have an impact on student achievement, although the exact nature is not clear. Phillips (1998) found that parental education and family socioeconomic status alone are not the only predictors of student academic achievement. Ferguson (1991) posited that in addition to SES, parental education accounted for variance in students test scores. Other researchers contend that dysfunctional home environments, low parental expectations, ineffective parenting, language differences and high levels of mobility might account for lower levels of academic achievement among students from lower socioeconomic backgrounds (Frymier&Gansneder, 1989; Laosa, 1978).

The literature has identified the lack of quality preschool education for minority children as a factor contributing to the achievement gaps between ethnic minority and non-minority students. Based on evidence from the National Longitudinal Survey of Youth (1998), many minority children start school with academic preparation that lags behind their white counterparts.

School resources are complex, and they compound. Abstract resources related to innovative teaching, staff development, planning time, teacher control and efficacy, and certain student support services are not always associated with financial commitments. These unique, personal factors can be as powerful and consistent in their effects as class size, teacher experience, or salaries, the resources than have dominated prior research. Furthermore, the factors leading to higher levels of complex and compound resources are variables such as school autonomy, collegial decision-making, and distributed leadership, whereas expenditure and revenue patterns are effective only in explaining simple resources (Grubb, 2009).

The Relationship between Spending and Student Achievement

Darling-Hammond (1999) used data from a 50-state survey of policies, state case study analyses, the 1993-94 Schools and Staffing Surveys (SASS), and the National Assessment of Educational Progress (NAEP), to study the ways in which teacher qualifications and school inputs are related to student achievement across states.

She found that at the aggregate state level, it was difficult to establish a direct relationship between spending and achievement. Per-pupil spending showed a significant positive relationship with student outcomes in 4th grade reading in 1993-94, but no

relationship with student outcomes in mathematics. This might be the case, the author theorized, because the spending measureincorporated resources spent not only on teacher salaries and professionaldevelopment but also on class sizes and other resources that may especiallysupport students in the early grades as they are learning to read. Althoughsalaries and spending are strongly related to one another, teacher salarylevels, unadjusted for cost of living differences, are not correlated with student outcomes when aggregated to the state level. Other school resources, such as pupil-teacher ratios, class size ratios, and the proportion of teachers in the school staff showed weak and rarely significant relationshipsto student achievement when they were aggregated to the state level (Darling-Hammond, 1999).

Studies of spending at the district level, however, have revealed patterns of effectiveness. Pan, Rudo, Schneider & Smith-Hansen, (2003) compared district spending and achievement levels in Arkansas, Louisiana, Texas and New Mexico. They found high-performing districts spent more on instruction as a share of current expenditures than low-performing districts, while in three states high-performing districts spent more on instruction per-pupil and employed more teachers per 1,000 students. The differences in resource allocation between the low-performing and high-performing groups were reduced in two of the four states when the comparisons controlled for demographic factors and socioeconomic status. A majority of the twelve districts identified as improving (but not high achieving) spent more per-pupil in instruction and instruction-related areas, and also increased allocations for these areas faster than comparison districts over the five-year period examined. At the same time, the twelve improving

districts were found to re-allocate resources away from administrative and other non-instructional areas (Pan, Rudo, Schneider & Smith-Hansen, 2003).

Districts with higher student academic performance spend more per-pupil on instruction and regular education programs. Expenditures on instruction account for almost sixty percent of operating expenditures. Program expenditures for regular education account for nearlytwo-thirds of program expenditures (Alexander, et. al, 2000).

High-performing districts demonstrate different resource allocation patterns in specific fiscal and staffing categories than low-performing districts. If the goal is to improve student performance, the key variables appear to be more intensive use of staff and greater professional development activities. Performance is associated with higher spending for instruction, tests and teaching materials and number of teachers, as well as lower spending for central office administrationand number of administrative staff. In addition, variations in capital outlays (spending on facility construction and maintenance), school-level administration (principal's office), and teacher education levels, were not associated with variations in achievement (Odden&Picus, 2004; Wenglinski, 2002).

Similarly, expenditures for functions outside of instruction, including school administration, instructional media, guidance, health services, extracurricular activities, and staff development, fail to show a significant relationship with math and reading performance once all of the student and school control variables are considered. The relationship between school expenditures and student achievement depends on how money is spent (Harter, 1999).

The Effect of Teacher Unions on Funding

In addition, the unionization of both teachers and non-certified staff in the public schools can have an impact on student achievement by the potential diversion of resources from activities that directly benefit students. Through the creation of rigid contracts patterned on the industrial model, school administrators are denied the flexibility to assign teachers and staff to where they will be most effective (Moe, 2009). Such difficulties lie at the root of the two fundamental problems that undercut accountability in schools. The agency problem arises because school employees (the agents) have their own interests distinct from those of the authorities (the principals, central office administrators, and school boards). The agents have institutional power giving the former the incentive and the capacity to resist top-down efforts to hold them accountable. The political problem arises because the authorities are elected officials who are responsive to the political power of school employees and thus have incentive to ignore true accountability. If school accountability is to succeed, reformers need to break from top-down methods of control and recognize that a combination of top-down and bottom-up approaches is more likely to yield results (Moe, 2003).

Funds raised at the local level are especially impacted by union agreement. Most of the dollars subject to local control are allocated via teacher hiring, salary increases, and work assignment decisions, which are structured by collective bargaining agreements. School boards often enter into these agreements with poor understanding of how funds are currently used and what a teacher labor contract will cost. In many recent cases, local school boards have approved contracts that would create significant budget deficits only two or three years later. Boards also frequently commit to pay teacher healthcare and pension contributions that cost little in the year they are made but have major “balloon

payments" later (Loeb and Miller 2007; Podgursky&Ehlert, 2007). As a result, many districts have limited flexibility in the ways they use locally raised funds. Districts also have a great deal of difficulty knowing precisely how education resources are spent (Hill, Roza& Harvey, 2008).

One contractual area where educational funds are diverted from classroom instructionis in post-retirement benefits. Upon retirement, some contracts provide health care benefits to retirees and their spouses. These contract provisions are indicative of strong union bargaining that gives direct benefits to union members no longer providing service and consumes considerable resources that might be used in the classroom for the benefit of students (Education Partnership, 2006).

Conversely, when strong management responsibilities are emphasized in collective bargaining agreements, the potential rises to align district goals between principals and agents. In 2004, the Chicago Public Schools (CPS) and Chicago Teachers Union signed a new collective bargaining agreement that gave principals the flexibility to dismiss probationary teachers (defined as those with less than five years of experience) for any reason, and without the elaborate documentation and hearing process typical in many large, urban school districts. Results suggest that the policy reduced annual teacher absences by roughly 10% and reduced the prevalence of teachers with 15 or more annual absences by 20%. The effects were strongest among teachers in elementary schools and in low-achieving, predominantly African-American high schools, and among teachers with high predicted absences. There is also evidence that the impact of the policy increased substantially after its first year (Jacob, 2010).

The Allocation of Resources in Schools

Research has produced a great deal of information about how dollars are distributed to school districts. However, there is insufficient data in the research on how to put dollars to productive use. From recent studies, it is known that most school district budgets are spent at and within school sites for a wide range of student services such as instruction, school leadership, counseling services, supplies, and materials. The remaining expenditures support the district administration, transportation, utilities, tax collection, insurance coverage, and other business and operating expenses (Odden& Archibald, 2001; Picus&Fazal, 1995). Nationally, spending for instruction represents 60 % of state and local operating expenditures (Odden& Busch,1998; Picus, 2001; Picus&Fazal, 1995).

Researchers have found that school districts are consistent in the way they allocate resources (Miles & Darling-Hammond, 1998). When funding levels rise due to state aid or property tax increases, districts use operating funds primarily for smaller class sizes and teacher pay increases. When more federal, grant or restricted funds are available, districts enhance instructional programs with new technology, teacher aides, and professional development linked to the program. (Picus&Fazal, 1995).

Most states were closely clustered around the national average (61.7%) in terms of the allocation toward direct instruction share of expenditures for the year 1999-2000. Alaska, Colorado, Kansas, New Mexico, and Oklahoma and the District of Columbia spent less than 58.0 percent of their current expenditures on instruction while three states, New York (68.1%), Maine (66.9%), and Massachusetts (66.8%), spent more than two-thirds of their expenditures on instruction (Johnson, 2003).

Grubb (2009) maintains that public schools are structured to poorly allocate resources. First, public education is driven by conventional interest group politics. The demand for jobs often is more powerful than that for enhanced learning, and so battles over the level and distribution of spending dominate educational politics. Second, several characteristics of schools as organizations: loose coupling, organizational inertia, instability, disagreement about goals, and the sheer effort of instruction, make it difficult to ensure changes in schools and teachers. In the existing fiscal climate, the lack of flexible resources may inhibit reform because teachers and administrators do not have the time to change their practices. Reforms that entail jointly necessary changes rather than piecemeal reform are particularly difficult under the conditions in many schools, including disagreements over goals and pedagogies, instability in personnel, and inconsistencies in perceptions of roles. Third, resources are inflexibly committed to salaries and benefits covered by contracts that cannot be changed in the short run. Even long-run changes may entail political battles, especially with unions. Other resources are embedded in school buildings and land, which are difficult and expensive to reconfigure. As incremental budgeting prevails, marginal changes occur from year to year. Many reforms end up being "more of the same," and if the old uses of resources were not particularly effective, the new ones will not be either(Grubb et al, 2006).

Schools often spend much less money per-pupil on core courses such as English and mathematics than on elective courses. Although results vary somewhat among the districts, class sizes (large classes for core courses, smaller classes for special electives), teacher salaries (senior teachers claim the elective courses for themselves), and different workloads (senior teachers often teach fewer courses), work together to skew spending.

Hence, students in elective courses get the benefit of more spending than students in core courses that determine high school graduation (on which state accountability plans focus) (Roza, 2008). District and school accounting can hide these spending patterns, and district leaders and principals are often unaware of how much they are spending or what other uses might be made of the same funds (Hill, Roza& Harvey, 2008).

Principals and teachers would often make different choices about use of the same money if they could. Schools in which principals have different degrees of control over spending (Roza, Davis, and Guin 2007), such as those in private, charter, and district-decentralized schools, hire larger numbers of teachers but pay lower salaries on average than district-run schools, where principals have no choices about whom to hire. Principals who have greater control over funds also focus their spending on generalist classroom teachers and part-time teachers and, relative to district-run schools, employ fewer administrators, classroom aides, and full-time specialist teachers (Hill, Roza& Harvey, 2008).

Districts also have a great deal of difficulty knowing where their money is spent or what things cost. This is true in part because districts maintain different accounting systems for items that are necessarily mingled together to run a school or deliver any instructional service. Thus, costs of salaries, benefits, facilities, technology, and private contracts for services are sometimes maintained in separate data systems, making it difficult to know the combined costs of any given resource or activity. The practice of keeping accounts district-wide means that it is almost impossible for district leaders to know exactly how much is spent on a particular school in the salary, benefits, or

technology accounts and therefore what is spent overall on any school (Hill, Roza& Harvey, 2008).

Both the lack of community resources and low levels of state aid may limit per-pupil spending. The local political decision to dedicate more local resources to municipal services may impact educational spending as well. These lower spending districts are closer to a spending threshold that tends to maximize educational spending for direct instruction, since there are insufficient resources to spend beyond the classroom. Once the threshold is met, however, districts tend to spend on more peripheral purposes to meet community needs: employing more local residents (maintenance workers, classroom aides, crossing guards), providing more student support (guidance, remedial and gifted teachers) and adding enrichment programs (after-school activities, sports, field trips) and enhancing facilities (building renovations, vehicle purchases, technology upgrades) (Guthrie, et al, 2007).The spending beyond the threshold may meet community needs and provide desired programs, but may not be related to academic achievement.

There is evidence that low-income, heavily state-subsidized school districts spend less efficiently than affluent school districts. As a general rule, the level of program operation or expansion matches the level of funds available. This matching occurs regardless of the theoretical "cost" of the program, that is, the minimum expenditure required to operate the program at a successful level. Related research on the local use of new money from school finance reforms has found similar patterns of resource use. Poor districts get more money and use it for clear needs (facilities, social services, compensatory education), but little of the new money makes it into the regular education program. The result is a system in which money rises, services expand outside the regular

classroom, but results in terms of student achievement stay flat or improve by only small amounts (Jefferson, 2005).

By state law (R.I.G.L. 16-7-23), Rhode Island communities must fund local schools at the same level as the previous year. State aid must be used to support local education functions, and should a district end a fiscal year with a surplus, those funds are carried over to the next year as a fund balance. For this reason, schools have little incentive to spend less or in a more efficient manner since they are encouraged to spend at least as much as the previous year, except in cases of significant enrollment decline when the budget can be reduced at a proportional level to the lower number of students.

Summary

Research supports a number of strategies that are associated with improved student performance. Under certain circumstances, reduced class size (Finn & Achilles, 1990; Grissmer et al., 1998; Krueger, 1998) and improving the quality of the teaching staff (Darling-Hammond & Sykes, 2003; Goe& Stickler, 2008; Rivkin, Hanushek&Kain, 2005) are associated with improved student performance. These actions require the allocation of financial resources because hiring additional teachers to decrease class size and increasing pay to attract quality teachers cost considerable sums. The research does not point to a simplistic application into an education production function (Normore&Ilon, 2006), but does point to focusing resources directly on the classroom.

Increasing expenditures from local sources or from state and federal revenues are not reliable methods of enhancing educational outcomes. Fiscal resources may be necessary but insufficient for some of these changes, and most important influences must be created by schools working as communities of practice, preferably with the support

and guidance of districts, to create the most effective resources (Grubb, 2006).Districts that allocate larger proportions of spending to direct classroom instruction have demonstrated a correlation with higher student achievement (Alexander, et. al, 200; Odden&Picus, 2003; Pan, Rudo, Schneider & Smith-Hansen, 2003; Wenglinski, 2002). This prioritization may be indicative of a lower incidence of agency problems (Honing, 2006; Loeb & McEwan, 2006).

CHAPTER 3

METHODOLOGY

The study examined spending and related achievement in Rhode Island public schools. At the macro level, total per-pupil spending was examined to determine if an association exists among student achievement in reading, mathematics and writing. Spending by district was divided into various allocation categories and compared to each other.

This study explored resource allocation and the relationship between the categories of resources and student achievement. Drawing on a review of the literature, it was hypothesized that, controlling for SES, student achievement would be positively associated with higher spending on direct instruction and not related to resource allocation directed to non-classroom use such as support staff, operations and specific employee benefits.

Hypotheses 1 through 4 were tested by conducting analysis using panel data from Rhode Island schools from 2005 through2008. Descriptive statistics were calculated for all data. The intent was to test the association among school expenditure categories on student performancewhile controlling for observed and unobserved confounders.

The models test the aggregated differences between the beginning and end of the time period of the studyof the association between spending categories and achievement at the school level. The assumption of independence is violated in Model 1as a result of multiple observations of individual schools occurring over time. Since spending and achievement are examined over a four yearperiod, clustered correlation exists. Correlated

data are common in educational and social science research. Longitudinal and hierarchically organized or clustered data represent two frequent analytical situations in which data within clusters are correlated (Ghisletta, &Spini, 2004).

In order to ensure valid statistical inference when some underlying regression model's assumptions are violated it is common to rely on robust standard errors. The most common of these alternative covariance matrix estimators was developed by Huber (1967), and White (1980). Provided that the residuals are independently distributed,standard errors which are obtained by aid of this estimator are consistent even if the residuals are heteroscedastic. Figure 3.1 shows the independent distribution of the standard residuals. This analysis utilized a robust estimator in the first linear regression in Model 1.Multiple regression was utilized in Model 2, which tested the association between the within-school change in per-pupil spending categories(direct instruction, teacher support, therapeutic support, operations, leadership, and other expenses), and the within-school change in student performance.

Table 3.1 lists the number of schools that meet the data requirements for the analysis for the years 2005 through 2008 for both models.

Table 3.1

Rhode Island Schools Participating in NECAPwithComplete Spending Data for the Period

Year	Schools
2005	231
2006	232
2007	278
2008	261

The New England Common Assessment Program (NECAP) is the standardized assessment instrument utilized by Rhode Island, New Hampshire, and Vermont for the time period under study (2005 through 2008). The NECAP is a series of reading, writing, mathematics and science achievement tests, administered annually, and developed in response to the Federal No Child Left Behind Act. The NECAP tests measure students' accumulated academic knowledge and skills relative to grade expectations created by teams of teachers representing the three states. Student scores are reported at four levels of academic achievement: Proficient with Distinction (level 4) Proficient (level 3), Partially Proficient (level 2) and Substantially Below Proficient (level 1). Reading and math are assessed in grades 3 to 8 and 11, and writing is assessed in grades 5, 8 and 11 (Rhode Island Department of Education, 2010).

The dependent variable for all models (DV) is the percentage of students in a given school who meet or exceed the standard (scores of level 3 and 4) on the (NECAP) in reading, mathematics and writing.

The use of percentages as a dependent variable has limitations since it is an aggregate of individual student performance and limited by its scale of 0 to 100. It was

chosen since it is easily understood, is public information, and no comparable measure is readily available as an indicator of school performance.

Data on spendingwere obtained from the Rhode Island Department of Education (RIDE) *In$ight* program. District expenditures are divided into one of five broad categories: Direct Instruction, Instructional Support, Operations, Other Commitments, and Leadership. The five function areas are composed of the activities described in Table 3.2. The spending category definitions remained constant throughout the study period. Therefore any changes over time in spending represent real changes in resource allocations.

Table 3.2

Spending Detail

Spending category	Description
Direct classroom instruction	Face-to-face classroom teaching (instructional teachers only, not including substitutes)
Instructional support	Student support: guidance services, library and media, student health services and extracurricular activities (therapeutic support) Teacher support: curriculum development, in-service and staff development, and sabbaticals Program support: management/administration, therapists, psychologists, evaluators, personal attendants, and social workers
Operations	Transportation, food service, safety, building upkeep, utilities, maintenance, and business services
Leadership	Building principal and administrative office staff
Other commitments	Contingencies, special education tuitions, capital projects, debt service, pass -through accounts, retiree benefits and legal obligations

Each category is further separated into the location of the expenditure at the school level (Rhode Island Department of Education, 2010).

The independent variables (IV) for Model 1 include: 1) spending on direct instruction per-pupil, per-pupil expenditures allocated to classroom instruction,andteacher salary/benefits; 2) teacher support per-pupil, per-pupil expenditures allocated to support curriculum development, and in-service and staff development; 3) therapeutic support per pupil and diagnostic and special education services;4) operations per pupil, including per-pupil expenditures allocated to the cost of utilities, maintenance, and maintenance staff salaries; 5) leadership per pupil, including per-pupil expenditures allocated to the cost of the building principal and the school office staff; 6)other expenses per pupil, including expenditures allocated to out-of-district special education, post-retirement benefits for teachers (a proxy for union strength), and legal expenses; and 7) percentage of students in each school who receive free and reduced lunch(a proxy for poverty).

The independent variables (IV) for Model 2 include: 1) annual changes in spending on direct instruction per pupil, including per-pupil expenditures allocated to classroom instruction and teacher salary/benefits; 2) annual changes in spending on teacher support, per pupil; 3) per-pupil expenditures allocated to therapeutic support; 4) annual changes in spending on operations per pupil, including per-pupil expenditures allocated to the cost of utilities, maintenance, and maintenance staff salaries; 5)annual changes in spending on leadership per pupil, including the per-pupil cost of building principal and the school office staff; 6) annual changes in spending on other expenses per pupil, including expenditures allocated to post-retirement benefits for teachers (a proxy

for union strength), and legal expenses;and 7) annual changes in the percentage of students in each school who receive free and reduced lunch (a proxy for poverty).

Financial and student assessment data from 2005 through 2008 were used to test the relationship between spending on direct instruction and student achievement in reading, mathematics and writing. The dependent and independent variables for Model 1 are defined in Table 3.3, and for Model 2 in Table 3.4. The data were examined at the school level.

Table 3.3

Description of Model 1 Variables

Variable	Specification	Data source
Dependent variables		
Student performance	Proportion of students who met or exceeded standard on the New England Common Assessment Program in grades 3, 8, and 11 in Reading, ELA and Math, 2005 through 2008	RIDE performance data
Independent variables		
Year	Year of assessment	RIDE
Poverty index per school	% of students who receive free and reduced price lunch in a school	RIDE
Direct classroom instruction per pupil	Per-pupil spending allocated to classroom instruction, including teacher salary/benefits	RIDE In$ight
Teacher support per-pupil	Per-pupil expenditures allocated to curriculum development, in-service, staff development and support	RIDE In$ight
Therapeutic support per-pupil	Per-pupil expenditures allocated to professionals serving the needs of a defined program (special education)	RIDE In$ight

Variable	Specification	Data source
Other expenditures per-pupil	Per-pupil cost of contingencies, special education tuitions, capital projects, debt service, pass-through accounts, retiree benefits and legal obligations	RIDE In$ight
Operations per-pupil	Per-pupil expenditures allocated to the cost of maintenance, utilities, and maintenance staff salaries	RIDE In$ight
Leadership per-pupil	Per-pupil spending allocated to the cost of building principal and the school office staff	RIDE In$ight

Table 3.4

Description of Model 2 Variables

Variable	Specification	Data source
Dependent variables		
ΔStudent performance	Within-school change in the proportion of students who met or exceeded standard on the New England Common Assessment Program in grades 3, 8 and 11 in Reading, ELA and Math between 2005 and 2008	RIDE performance data
Independent variables		
Year	Year of assessment	RIDE
ΔPoverty index per school	Within-school change in the % of students who receive free and reduced price lunch between 2005 and 2008	RIDE
ΔDirect classroom instruction/pupil	Within-school change in per-pupil spending allocated to classroom instruction, including teacher salary/benefits between 2005 and 2008	RIDE In$ight

Variable	Specification	Data source
ΔTeacher support/pupil	Within-school change in per-pupil spending allocated to curriculum development, in-service, staff development and support between 2005 and 2008	RIDE In$ight
ΔTherapeutic support/pupil	Within-school change in per-pupil spending allocated to professionals serving the needs of a defined program (special education) between 2005 and 2008	RIDE In$ight
Δ Other expenditures/pupil	Within-school change in per-pupil spending allocated to contingencies, special education tuitions, capital projects, debt service, pass-through accounts, retiree benefits and legal obligations between 2005 and 2008	RIDE In$ight
Δ Operations/pupil	Within-school change in per-pupil spending allocated to the cost of maintenance, utilities, maintenance staff salaries between 2005 and 2008	RIDE In$ight
Δ Leadership/pupil	Within-school change in per-pupil spending allocated to the cost of building principal and the school office staff between 2005 and 2008	RIDE In$ight

Two separate model specifications were estimated to test the study hypotheses. Model 1 tested Hypotheses one and two. Model 2 tested Hypotheses three and four.The alternative specifications are two different analytic approaches to address and test the same hypotheses. The first pooled performance and financial data cover the period 2005 through 2008 for reading, mathematics and writing. This model evaluates the cross-sectional relationship between resource use and student achievement. All student achievement and financial data will be modeled at the school level. The following model was estimated for school *i* at time *t*:

Model 1 Equation

$$Performance_{it} = b_0 + b_1\, year_t + b_2\, \%\ students\ receiving\ free\ and\ reduced\ price\ lunch_{it} + b_3\ per\ pupil\ spending\ on\ direct\ instruction_{it} + b_4\ per\ pupil\ spending\ on\ teacher\ support_{it} + b_5\ per\ pupil\ spending\ on\ therapeutic\ support_{it} + b_6 per\ pupil\ spending\ on\ operations_{it} + b_7\ spending\ per\ pupil\ on\ other\ expenses_{it} + b_8\ per\ pupil\ spending\ on\ leadership + e_{it}$$

Performance is the percentage of students that met or exceeded the standard on the New England Common Assessment Program. The model estimated separately for reading, math, and writing performance. In this equation, *Year* is the variable for the year of test administration (capturing trends in student achievement), *% students receiving free and reduced price lunch* is a proxy for SES, spending variables (direct instruction, teacher support, therapeutic support, operations, leadership, and other expenditures) are the per-pupil cost of spending for given spending categories.

It was hypothesized that b_3, the relationship between spending on direct instruction and performance,would be statistically significant in a positive direction,

while the coefficients on the spending variables of pupil support, operations, leadership, and other expenditures would be either non-significant or significant in a negative direction.

While the first model tested the relationship between resource use and student achievement, it omits a number of unmeasured variables that affect student performance. These include teacher quality, parental support, individual student ability, and school climate, all of which can contribute to school effectiveness but are not readily measureable on a financial basis. To address the potential confounding from these omitted factors, a second, longitudinal model was estimated. This model was based on the assumption that the unmeasured factors omitted from the first specification are largely constant within schools over time. Therefore, by subtracting variable values within schools across adjacent periods, the unmeasured variables would be effectively canceled out, decreasing confounding and allowing for better estimates of the association between resource use and student achievement. The following model was estimated for school *i*, in time *t*where all variables are defined as before and Δ indicates the change in a variable between a given year and the previous year:

Model 2 Equation

$$\Delta Performance_{it} = b_0 + b_1\, year_t + b_2 \Delta\%\ students\ receiving\ free\ and\ reduced\ price\ lunch_{it} + b_3\ \Delta\ per\ pupil\ spending\ on\ direct\ instruction_{it} + b_4\, \Delta per\ pupil\ spending\ on\ teacher\ support_{it} + b_5\, \Delta\ per\ pupil\ spending\ on\ therapeutic\ support_{it} + b_6\, \Delta\ per\ pupil\ spending\ on\ operations_{it} + b_7\ \Delta\ spending\ per\ pupil\ on\ other\ expenses_{it} + b_8\, \Delta\ per\ pupil\ spending\ on\ leadership_{it} + e_{it}$$

This captures changes in performance due to outside factors. This model controlled for a number of factors, including teacher quality, which may confound the relationship between spending and achievement.

By accounting for unobserved confounders and by estimating the model in changes, it was expected that b_3, the association between the within-school change in per-pupil spending on direct instruction and the within-school change in student performance would be smaller than the association observed in Model 1. This is because of an expected number of important unmeasured factors (e.g. teacher and administrator quality, parental and community incentive to perform) to be positively correlated with both spending on direct instruction and student performance. By estimating the model in changes, these unmeasured factors would be accounted for, and by doing so it was reasonable to expect a smaller effect of spending on direct student instruction on student performance.

The second model examined the change of the variables. Should the model reveal non-significant results, it would be difficult to conclude whether the factors were insignificant or if the model lacked the power to detect them. For this reason the changes were tested over the four year period.

All analyses used an alpha level of .05 to determine statistical significance.

Evaluation of Regression Assumptions

The assumptions of regression were tested through the examination of residuals. First, the standardized residuals were examined for departures from normality. If residuals are normally distributed, approximately 5% of the cases are expected to be

beyond plus or minus two standard deviations. The prevalence of outliers was evaluated by calculating the proportion of standardized residuals with values between 1.96 and -1.96. In Model 1, given the sample size of 1002, approximately 50 cases would be expected to have standardized residual values that fall outside this range. Figure 3.1 shows the histogram of the standardized residual. Appendix Ashows the casewise diagnostics. For the dependent variable reading, six standardized residuals have absolute values greater than 1.96, for the dependent variable math, 14, and for writing, four. This analysis indicates that fewer residuals are falling in the tails of the distribution than would be expected by chance alone, suggesting that outliers are not having a substantial influence on the results. Figure 3.2 also shows that the residuals for each of the dependent variables in Model 2 are distributed approximately normal.

The homoscedasticity assumption was tested by evaluating the correlation of residuals within schools across the four-year study period. To do this, an ANOVA was performed (Table 3.6), where the standardized residual was the outcome and the school indicator was the factor variable. This analysis found that the school factor was a significant predictor of the residuals, indicating the clustering of errors within schools in Model 1 ($F= 5.42$ (277, 695), $p<.05$).

Testing the homoscedasticity assumption was performed for Model 2 using the Breusch-Pagan test. After differencing between years 4 and 1 of the panel, the Model 2 included only one observation from each school, making the Breusch-Pagan test appropriate for the cross-sectional data (White, 1980). The Breusch-Pagan test rejected the assumption of homoscedasticity for reading (the probability of constant variance was

.03) and math (the probability of constant variance was .0042) but not for writing (the probability of constant variance was .668).

The aggregate data in Model 1 meets all the assumptions except for the assumption of homoscedasticity. Thus the assumption of independence is violated and multiple regression cannot be utilized in Model 1. Instead, a generalized linear model is estimated which calculates cluster-robust standard errors, based on the assumption that errors are non-independent within schools, but independent across schools.

The assumption of independence is violated in Model 1as a result of multiple observations of individual schools occurring over time. Since spending and achievement are examined over a four-year period, clustered correlation exists. Correlated data are common in educational and social science research. Longitudinal and hierarchically organized or clustered data represent two frequent analytical situations in which data within clusters are correlated (Ghisletta, &Spini, 2004).

In order to ensure valid statistical inference when some underlying regression model's assumptions are violated it is common to rely on "robust" standard errors. The most common of these alternative covariance matrix estimators has been developed by Huber (1967), and White (1980). Provided that the residuals are independently distributed, standard errors that are obtained by aid of this estimator are consistent even if the residuals are heteroscedastic. Figure 3.1 shows the independent distribution of the standard residuals. This analysis utilized a robust estimator in the first linear regression model.

To address the violation to the homoscedasticity assumption in Model 1, a generalized linear model was estimated which calculated cluster-robust standard errors, based on the assumption that errors are non-independent within schools, but independent across schools. In Model 2, a generalized linear model using heteroscedasticitiy-consistent standard errors (Huber 1980) was estimated to appropriately calculate standard errors given the violation of the homoscedasticity assumption for two of the three dependent variables.

Table 3.5

ANOVA Standardized Residuals Outcome (School is the Factor)in Model 1

	Sum of Squares	df	Mean Squares	F	Sig.
Between Groups	659.83	277	2.38	5.42	.000
Within Groups	305.16	695	.43		
Total	965.00	972			

Figure 3.1

Histogram of Model 1 Variables

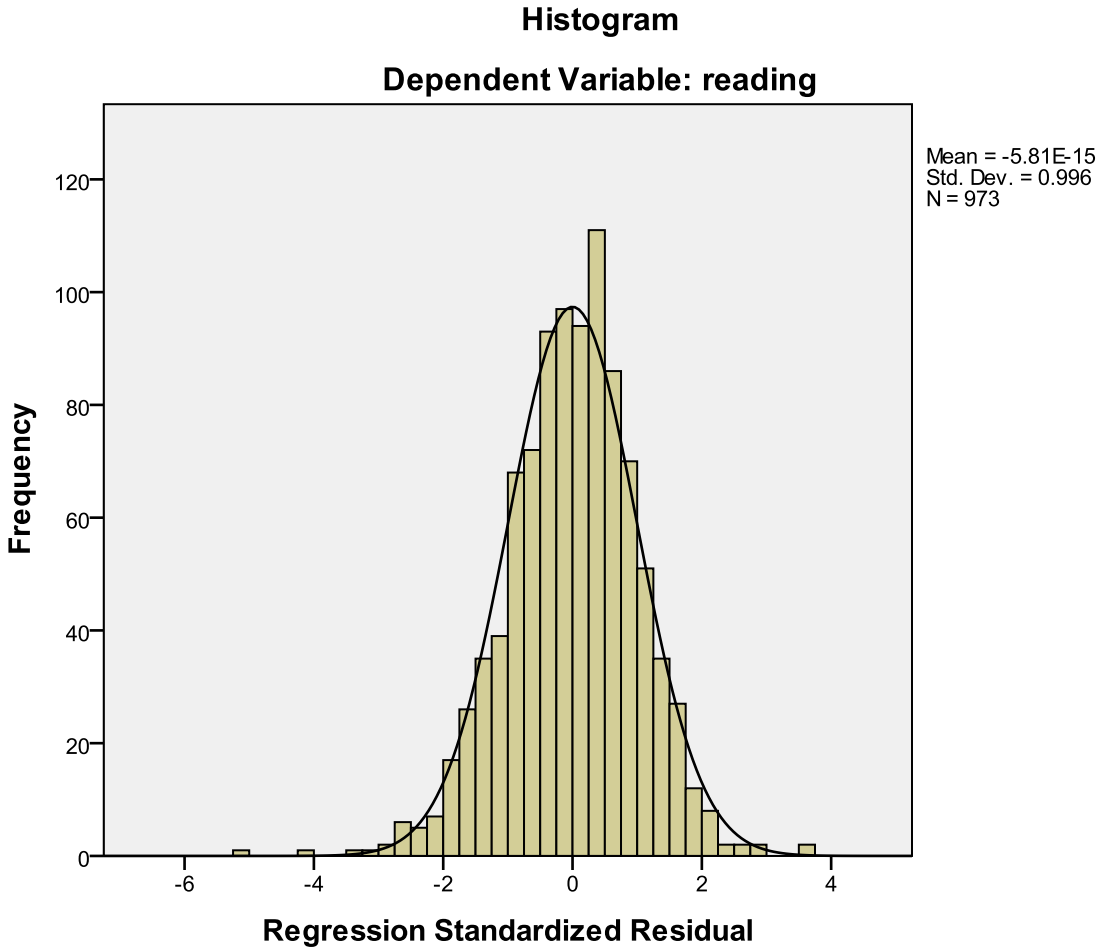
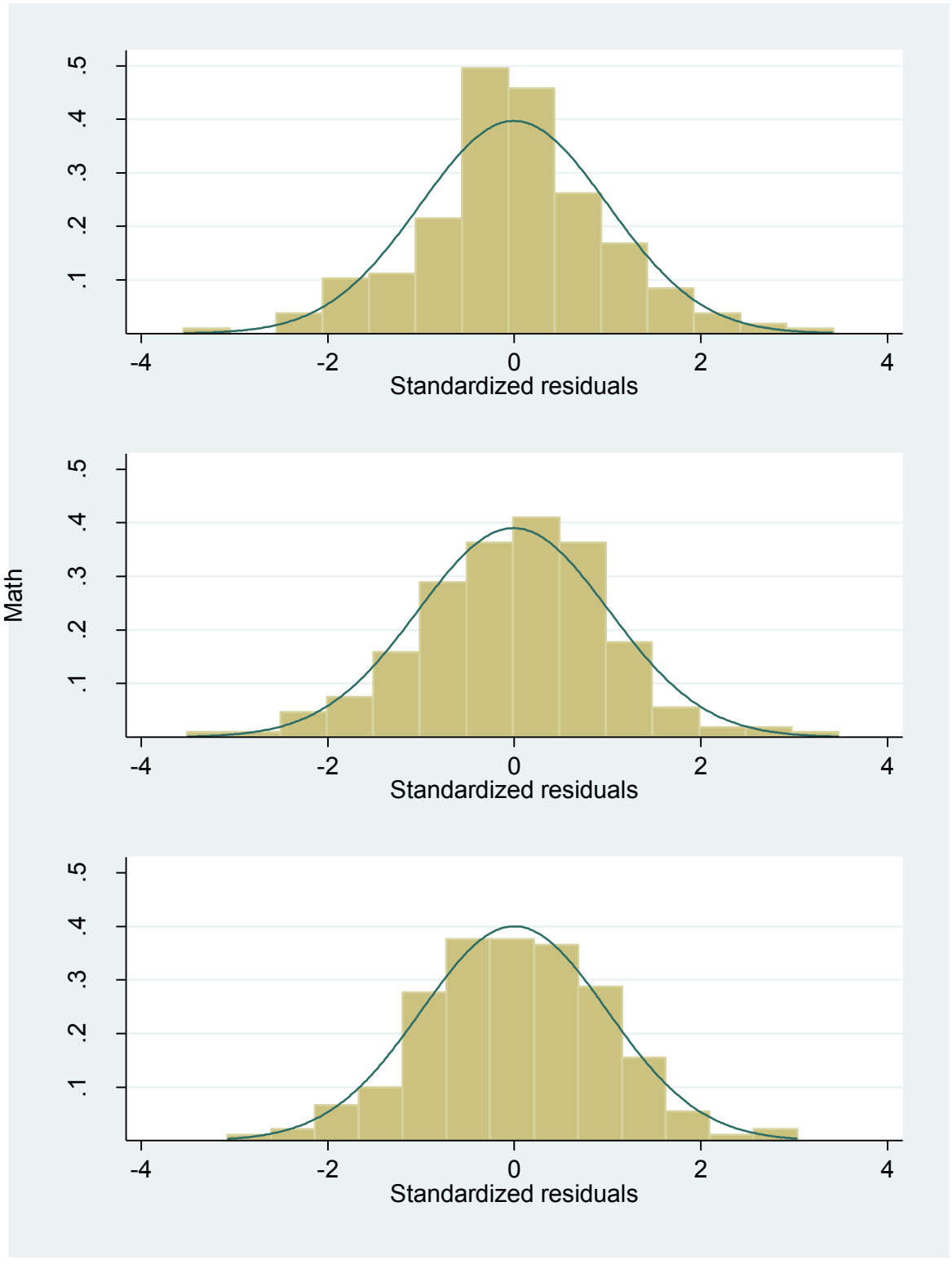


Figure 3.2

Histogram of Model 2 Variables


Math
.1
.2
.3
.4
.5
-4
-2
0
2
4
Standardized residuals
.1
.2
.3
.4
.5
-4
-2
0
2
4
Standardized residuals
.1
.2
.3
.4
.5
-4
-2
0
2
4
Standardized residuals

CHAPTER 4

RESULTS

The central question in this study was whether there exists an association between spending allocations and student achievement. The study was guided by two Research Questions:

Research Question 1: What is the relationship between spending on public education in Rhode Island and student achievement?

Research Question 2: What is the relationship between annual changes in spending on public education in Rhode Island and annual changes in student achievement?

These Research Questions were further focused by four Research Hypotheses:

Hypothesis 1: Higher per-pupil spending on direct instruction at the school level is associated with higher student reading, math, and writing performance.

Hypothesis 2: Higher per-pupil spending on instructional support, operations, leadership and other commitments at the school level are not associated with higher student reading, math, and writing performance.

Hypothesis3: School-level changes in per-pupil spending on direct instruction are associated with changes in student reading, math, and writing performance.

Hypothesis 4: School-level changes in per-pupil spending on instructional support, operations, leadership and other commitments are not associated with changes in student reading, math, and writing performance.

This section first displays results from descriptive analysis of spending and student achievement in Rhode Island from 2005-2008. It then shows the results from two separate multivariate model specifications test the relationship between spending and student achievement.

Descriptive Analysis

Table 4.1 shows the means and standard deviations of the percentage of students who met or exceeded standard in reading, math, and writing on the NECAP assessment and spending by expenditure category (instructional teachers, teacher support, student therapeutic support, operations, other expenditures, leadership, and the proportion of students receiving free and reduced price lunch. The sample size (n=1002) represents data points for all the public schools in Rhode Island with complete data for the period. Table 4.1 shows that the mean school-level rate of meeting the NECAP standard in Rhode Island was approximately 65% for reading, 53% for math, and 51% for writing between 2005 and 2008. Reading performance increased steadily throughout the study period while math and writing scores remained relatively unchanged. Table 4.1 also shows that the largest school expenditures were for instructional teaching ($7140 per pupil in 2008), followed by spending on therapeutic support ($1201 per pupil in 2008), operations ($1084 per pupil in 2008), other expenses ($885 per pupil in 2008), teacher support ($770 per pupil in 2008), and leadership ($686 per pupil in 2008). The large

standard deviations for instructional teaching, and particularly for therapeutic support, indicate a great degree of variation in spending patterns across schools. Each spending category increased over the study period while the proportion of students receiving free and reduced priced lunch was stable.

Table 4.1

Means and Standard Deviations for Variables in Model for Reading, Math and Writing, 2005 through 2008

Variable	2005		2006		2007		2008	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Percent that met or exceeded standard on NECAP Reading	61.50	18.61	65.08	17.58	65.56	17.51	68.98	15.76
Percent that met or exceeded standard on NECAP Math	53.03	19.13	56.32	18.25	50.71	22.64	53.87	22.31
Percent that met or exceeded standard on NECAP Writing	54.24	17.62	48.78	20.45	48.40	19.64	53.03	19.17
Instructional teaching per pupil	6003	1490	6404	1903	6781	1630	7140	1696
Teacher support per pupil	586	288	643	310	743	361	770	375
Therapeutic support per pupil	889	1739	1148	1962	1106	2065	1201	1398
Operations per pupil	888	353	1005	712	1021	390	1084	494
Other expense per pupil	808	490	854	531	868	497	885	515
Leadership per pupil	603	293	659	338	690	360	686	265
Free and reduced lunch	34.69	30.32	35.07	30.31	33.67	27.42	33.44	26.49

Sample size: 2005 n=231; 2006 n=232; 2007 n = 278; 2008 n=261

Sample sizes are reduced due to missing writing data for some schools

Table 4.2 shows the means and standard deviations of the differences of expenditure category (instructional teachers, teacher support, student therapeutic support, operations, other expenditures, leadership, and the proportion of students receiving free and reduced price lunch) between the base yearof 2005 and 2008, the last year of the study period. The sample size (n=215) represents the differences between 2005 and 2008 of all the public schools in Rhode Island with complete data for the period. Table 4.2 shows that the mean difference in school-level rate of meeting the NECAP standard in Rhode Island was approximately 8.31 % for reading, 7.28 % for math, and 2.19 % for writing between 2005 and 2008. Table 4.2 also shows that the largest increase in school expenditures was for instructional teaching ($1264 per pupil), followed by spending on therapeutic support ($393 per pupil), operations ($193 per pupil), teacher support ($118 per pupil), other expenses ($95 per pupil), and leadership ($91 per pupil). The large standard deviations for instructional teaching and the other spending categories, particularly for therapeutic support, indicate a great degree of variation in spending patterns across schools.

Table 4.2
Means and Standard Deviations for Variables in Model 2 for the Differences in Reading, Math and Writing between the Years 2005 and 2008

Variable	Mean	SD
Percent that met or exceeded standard on NECAP Reading	8.31	7.58
Percent that met or exceeded standard on NECAP Math	7.28	9.22
Percent that met or exceeded standard on NECAP Reading Writing	2.19	13.68
Change in spending: Instruction/teaching per pupil	$1264	$1329
Change in spending:Teachersupport per pupil	$118	$172
Change in spending:Therapeutic support per pupil	$393	$759
Change in spending:Operations per pupil	$193	$368
Change in spending:Other expense per pupil	$95	$292
Change in spending:Leadership per pupil	$91	$204
Change in spending:Free and reduced lunch	-.86	9.43

Sample size = 215

Model 1 Analysis

Model 1 pools school-level observations from 2005 through 2008 and usesa generalized linear model to account for the non-independence of observationsto estimate the relationship between the spending categories and achievement for reading, writing,

and math. In all models, the spending categories are in units of $1000 per pupil. Therefore, model coefficient values are interpreted as the effect of increased per-pupil spending by $1000 with the change in the proportion of schools that meet or exceed standard on NECAP reading, mathematics and writing assessments.

Reading

Table 4.3 shows the summary of the Model 1 analysis for reading. The relationship between the dependent variable (reading) and the independent variables instructional teaching, therapeutic support, the percentage of students receiving free and reduced price lunch, and the year is significant ($F(10, 279) = 171.47$, $p < .05$). The effect size ($R^2 = .76$) shows that 76% of the variation in reading scores can be explained by the model. There are 1002 total observations. The standard error is adjusted for 280 schools over the four-year period.

Table 4.3 shows the associations between the dependent variable, reading and the independent variables. Of the spending categories, instructional teaching is positively associated with reading achievement. Based on the model, an expenditure of $1000 would increase the number of students in reading proficiency by 1.75 percentage points. The therapeutic support is negatively associated with reading gains. The model predicts that allocations decrease the percentage of students reaching proficiency by 2.16 for each $1000 allocated to this expense.

The percentage of students receiving free and reduced price lunch is negatively associated with reading performance. The model predicts that for each one percentage

point increase by students in this category, reading performance will decline .49 percentage points.

The testing year is also significantly and positively associated with reading scores indicating an upward trend in reading performance that was unexplained by the other model variables. These factors could be greater teacher emphasis on student performance, increased test preparation and skill development, greater community awareness regarding the importance of the assessments, and higher parental expectations.

Table 4.3

Summary of Model 1 Regression Analysis for the Variables Associated with Reading Achievement
2005-2008 (n = 1002, S.E. Adjusted for 280 Clusters by School)

Variable	*B*	*SE B*
Spending on Instructional teachers per pupil in thousands of dollars	1.75*	.41
Spending on Teacher support per pupilin thousands of dollars	-2.32	1.49
Spending on Therapeutic support per pupilin thousands of dollars	-2.16*	.26
Spending on Operations expense per pupilin thousands of dollars	-1.71	1.15
Spending on Leadership expense per pupilin thousands of dollars	-2.77	1.61
Spending on Other expenses per pupilin thousands of dollars	-.95	.62
Proportion of students receiving free and reduced price lunch	-.49*	.01
Year 2006	4.15*	.42
Year 2007	3.54*	.68
Year 2008	6.60*	.71

$R^2 = .76$
*p < .05

Math

Table 4.4 shows the summary of the Model 1 analysis for math. The relationship between the dependent variable (math) and the independent variables, including instructional teaching, teacher support, therapeutic support, the percentage of students receiving free and reduced price lunch and the first year of testing are significant ($F(10, 279) = 84.95$, $p < .05$). The effect size ($R^2 = .55$) shows that 55% of the variation in reading scores can be explained by the model. There are 1002 total observations. The standard error is adjusted for 280 schools over the four-year period.

Table 4.4 shows the associations between the dependent variable, math and the independent variables. Of the spending categories, instructional teaching is positively associated with math achievement. Based on the model, an expenditure of $1000 would increase the number of students achieving math proficiency by 3.03 percentage points. Teacher and therapeutic support are negatively associated with math performance. The model predicts that as allocations are increased, the percentage of students reaching proficiency decreases by 14.99 percentage points for teacher support and 2.78 for therapeutic support for each $1000 allocated.

The percentage of students receiving free and reduced price lunch is negatively associated with math performance. The model predicts that for each one percentage point increase by students in this category, math performance will decline .48 percentage points.

The 2006 testing year is also significantly associated with math growth indicating that factors not included in the analysis had an impact on student performance on the NECAP. This could indicate the trend toward higher scores as teachers place more

emphasis on student performance and increase test preparation and skill development. However, scores dropped in 2007 and increased only slightly in 2008, although these results were not significant. This one year rise may be indicative of better test preparation that occurred in the second year of the period but leveled off in following years.

Table 4.4

Summary of Model 1 Regression Analysis for the Variables Associated with Math Achievement

2005 through 2008 (n = 1002, S.E. Adjusted for 280 Clusters by School)

Variable	*B*	*SE B*
Spending on Instructional teachers per pupil in thousands of dollars	3.03*	.72
Spending on Teacher support per pupilin thousands of dollars	-14.99*	3.02
Spending on Therapeutic support per pupil in thousands of dollars	-2.78*	.60
Spending on Operations expense per pupil in thousands of dollars	-3.06	1.75
Spending on Leadership expense per pupil in thousands of dollarsin thousands of dollars	-2.56	2.30
Spending on Other expense per pupil in thousands of dollars	-.01	1.03
Proportion of students receiving free and reduced lunch	-.48*	.02
Year 2006	4.33*	.53
Year 2007	-1.58	1.08
Year 2008	1.22	1.29

$R^2 = .56$

*($p < .05$)

Writing

Table 4.5 shows the summary of the Model 1 analysis for writing. The relationship between the dependent variable (writing) and the independent variablesincluding:instructional teaching, teacher support, therapeutic support, the percentage of students receiving free and reduced price lunch, and the first year of testing are significant ($F(10, 260) = 51.70$, $p < .05$). The effect size ($R^2 = .46$) shows that 46% of the variation in reading scores can be explained by the model. There are 908 total observations. The standard error is adjusted for 261 schools over the four-year period.

Table 4.5 shows the associations between the dependent variable, math, and the independent variables. Of the spending categories, instructional teaching is positively associated with writing achievement. Based on the model, $1000 in expenditures would increase the number of students achieving math proficiency by 2.71 percentage points. Teacher and therapeutic support for are negatively associated with writing performance. The model predicts that allocations decrease the percentage of students reaching proficiency by 11.25 percentage points for teacher support and 2.33 for therapeutic support for each $1000 allocated.

The percentage of students receiving free and reduced price lunch is negatively associated with writing performance. The model predicts that for each one percentage point increase by students in this category, writing performance will decline .39 percentage points.

The first two testing years are also significantly and negatively associated negative writing scores, indicating that factors not included in the analysis had an impact on student performance on the NECAP.

Table 4.5

Summary of Model 1 Regression Analysis for the Variables Associated with Writing Achievement

2005-2008 (n = 908, S.E. Adjusted for 261 Clusters by School)

Variable	*B*	*SE B*
Spending on instructional teachers per pupil in thousands of dollars	2.71*	.69
Spending on teacher support per pupil in thousands of dollars	-11.25*	1.94
Spending on therapeutic support per pupil in thousands of dollars	-2.33*	.41
Spending on operations expense per pupil in thousands of dollars	-2.84	1.72
Spending on leadership expense per pupil in thousands of dollars	-4.94*	1.93
Spending on other expense per pupilin thousands of dollars	-.39	1.29
Proportion of students receiving free and reduced lunch	-.39*	.02
Year 2006	-4.45*	1.08
Year 2007	-5.64*	1.20
Year 2008	-1.36	1.24

$R^2 = .46$

*($p < .05$)

Model 2 Summary

Reading

Table 4.6 shows the summary of the Model 2 analysis for changes in reading and the independent variables instructional teaching, teacher support, therapeutic support, the percentage of students receiving free and reduced price lunch between 2005 and 2008. The percentage of students receiving free and reduced price lunch is significant ($F(7, 216) = 8.39$), $p < .05$).The effect size ($R^2 = .03$) shows that 3% of the variation in the change in reading scores can be explained by the model. There are 217 total observations.

The change in students receiving free and reduced priced lunch is the only predictor of change in reading achievement. The percentage of students receiving free and reduced price lunch is negatively associated with change in reading performance. The model predicts that for each one percentage point increase by students in this category, reading performance will decline .29 percentage points.

Table 4.6

Model 2 Regression Analysis for the Variables Associated with Changes in Reading Achievement (2008 values minus 2005 values)

(n = 217)

Variable	*B*	*SE B*
Change in instructional teachers per pupil	-.21	1.69
Change in teacher support per pupil	-4.91	11.26
Change in therapeutic support per pupil	2.18	1.16
Change in operations expense per pupil	2.76	6.35
Change in leadership expense per pupil	-.07	3.90
Change in other expense per pupil	-6.62	8.89
Change in the proportion of students receiving free and reduced price lunch	-.29*	.13

$R^2 = .03$

*($p < .05$)

Table 4.7 shows the summary of the Model 2 analysis for changes in math performance. The relationship between the dependent variable (the difference in math performance between year 4 and year 1) and the corresponding changes of the independent variables instructional teaching, teacher support, therapeutic support, the percentage of students receiving free and reduced price lunch and the first year of testing are significant ($F(5, 214) = 2.78$), $p < .05$). The effect size ($R^2 = .03$) shows that 3% of the variation in the change in math scores can be explained by the model. There are 215 total observations.

None of the independent variables are associated with the differences in math performance between year 4 (2008) and year 1 (2005).

Table 4.7

Model 2 Regression Analysis for the Variables Associated with Changes in Math Achievement (2008 values minus 2005 values)

(n = 215)

Variable	*B*	*SE B*
Change in instructional teachers per pupil	.06	.45
Change in teacher support per pupil	2.52	2.67
Change in therapeutic support per pupil	1.38	.81
Change in operations expense per pupil	2.06	6.15
Change in leadership expense per pupil	-1.69	3.23
Change in other expense per pupil	2.622	2.89
Change in the proportion of students receiving free and reduced price lunch	-.13	.07

$R^2 = .03$

*($p < .05$)

Writing

Table 4.8 shows the summary of the Model 2 analysis for changes in writing performance. The relationship between the dependent variable (the difference in writing performance between year 4 and year 1) and the corresponding changes of the independent variables instructional teaching, teacher support, therapeutic support, the percentage of students receiving free and reduced price lunch, and the first year of testing are significant ($F (5, 191) = 5.32$), $p < .05$). The effect size ($R^2 = .02$) shows that 2% of the variation in the change in writing scores can be explained by the model. There are 192 total observations.

None of the independent variables are associated with the differences in writing performance between year 4 (2008) and year 1 (2005).

Table 4.8

Model 2 Regression Analysis for the Variables Associated with Changes in Writing Achievement

(2008 values minus 2005 values)

(n = 192)

Variable	*B*	*SE B*
Change in instructional teachers per pupil	-1.05	.72
Change in teacher support per pupil	-.93	6.57
Change in therapeutic support per pupil	-2.70	3.92
Change in operations expense per pupil	2.26	3.35
Change in leadership expense per pupil	1.91	3.72
Change in other expense per pupil	2.62	4.56
Change in the proportion of students receiving free and reduced price lunch	.10	.20

$R^2 = .02$

*($p < .05$)

Summary

These results indicate that Hypothesis 1: Higher per-pupil spending on direct instruction at the school level is associated with higher student reading, math, and writing performance was supported by the positive associations determined by Model 1 analysis.

These results indicate that Hypothesis 2: Higher per-pupil spending on instructional support, operations, leadership and other commitments at the school level are not associated with higher student reading, math, and writing performance was supported by the negative associations determined by Model 1 analysis.

These results indicate that Hypothesis 3: School-level changes in per-pupil spending on direct instruction are associated with changes in student reading, math, and writing performance was not supported due to the absence of statistically significant associations as determined by Model 2 analysis.

These results indicate that Hypothesis 4: School-level changes in per-pupil spending on instructional support, operations, leadership and other commitments are not associated with changes in student reading, math, and writing performance was not supported due to the absence of statistically significant associations as determined by Model 2 analysis.

Limitations

There were a number of limitations to the study. In the case of the dependent variable, the effects of schooling were not limited solely to test results, which at best, represented a composite assessment of the knowledge and skills acquired by the student

at a particular point in time. Standardized assessments are not the only measure of school effectiveness. Schools have many goals, including social, developmental, and academic.

The use of percentages as a dependent variable has limitations since it is an aggregate of individual student performance and limited by its scale of 0 to 100. It was chosen because it is easily understood, was public information, and no comparable measure was readily available as an indicator of school performance.

The In$ight spending data covered broad spending categories which does not allow for more fine grained assessment of spending detail. For this reason, it was abandoned by RIDE in favor of the Uniform Chart of Accounts (UCOA). School level UCOA was not available until after 2008, the end period of the study. Nonetheless, the In$ight data provides important information on school spending choices throughout the study period which allowed for the assessment of how these broad patters of spending were related to school achievement.

The results are limited to the school level and do not evaluate within-school differences and the effect of spending on achievement. The results may not be generalizable to other states.

Other limitations emerged specifically in Model 2. Model 1 pooled school data from 2004-2008 but did not measure student characteristics or teacher quality and interpretation of the model may be biased by unobserved confounders. Thus Model 2 was needed. It assumed teacher quality and student characteristics were constant over the study period and cancelled them out therefore allowing the model to analyze the effect of resources on achievement. The model used multiple regression differencing methods but

the results identified no statistically significant association between resource allocation and student performance.

One limitation from Model 2 is that if unobserved characteristics were not constant within schools over time, and that these characteristics were related to spending categories, then the model would yield biased coefficient estimates. Future research that better assessed school and student characteristics could potentially address this situation. For instance teacher quality and other independent variables strongly associated with student performance (Darling-Hammond & Sykes, 2003; Rivkin, Hanushek&Kain, 2005; Wenglinsky, 2002)might have been included in the model to better estimate the relationship between spending and achievement.RIDE data on teacher practice, experience, and certification might have also identified a relationship between human resource allocation and achievement.

Future research should therefore focus on identifying and measuring other important school and student characteristics that could confound the relationship between spending and achievement. This could result in a third model that explored the association between resource allocation and teacher performance as determined by evaluation results and a richer set of control variables.

Finally, other modeling techniques, making different assumptions about the correlation of observations within schools, could have been employed in the study. To address the clustering of observations within schools, Hierarchical Linear Modeling (HLM) might have been utilized to estimate school-level parameters and variance estimates.

Strengths

Strengths of the analyses include the fact that the study:

1. Utilized a large sample size of pooled data over time
2. Included easily understood public data; and
3. Addressed the current RIDE agenda by linking the output-based Basic Education Plan, the newly adopted funding formula, and the uniform chart of accounts (UCOA)

CHAPTER 5

DISCUSSION AND IMPLICATIONS

This study evaluated the relationship between school spending and achievement in Rhode Island between 2005 and 2008. It was not unexpected to see differences in achievement levels related to family income and community of residence. In this study, student eligibility for free and reduced price lunch was used as a proxy for student poverty. The mean percentage of this for the state is 35%, but in the urban communities, the percentage is much higher. In Central Falls, 85.2% of the students qualify, followed by Providence (78%), Pawtucket (64%), Woonsocket (63.9%) and Newport (51.3%). In more affluent rural and suburban communities, the situation is reversed: 3.2% of Barrington students qualify followed by East Greenwich (4.9%), Portsmouth (6.8%), Scituate (7.0%), Little Compton (7.0%), and Jamestown (7.1%).

Schools in wealthy suburban communities such as Barrington and East Greenwich,may see 90% of their students meet or exceed standard on reading assessments, while in the poorer, urban cities of Providence and Central Falls, the success rate may be in the 30% range. Math performance can even be worse, where in some schools, less than 10% of the student population meets standard. The mean state achievement levels in reading (65.20), math (53.09) and writing (51.02) may not be surprising, but the variations in scores as evidenced by the standard deviations are a cause for concern: reading (17.53), math (20.92) and writing (19.41) show a state where between 82.73 and 47.67 of the students meet or exceed standard in reading, which contains 68.2% (one standard deviation) of the students. In math, 68.2% of the students fall between 74.01 and 32.17, and in writing, 70.43 and 31.61. These data indicates

significant achievement gaps between districts in the state. These gaps are closely associated with family income and the effects of poverty and confirmed by extensive research (Coleman et. al., 1966, Reynolds & Walberg, 1992; Sirin, 2005;Wenglinsky, 1998).

In addition to the achievement gaps, are the wide variations in spending patterns found across schools. In terms of total spending for the period of study, the state mean was $12371 per pupil. Some small districts such as New Shorham (Block Island) ($24,083), Jamestown ($16744) and Little Compton ($16099) spend far more due to their lack of economies of scale or high school tuition and transportation costs (Little Compton and Jamestown have K – 8 programs and tuition their high school students to neighboring communities). Yet there are major differences between more similar communities. For the period of the study, Narragansett spent $14,947 per pupil, Gloucester $14,187, Foster, $14,166 and South Kingston $14,058, while Cumberland spent $9,720, Barrington $9,909 and Portsmouth $10,305.

Of the urban communities, Newport exceeds the state mean by spending $13,790 per pupil, Central Falls $13,463, and Providence $13,141. Woonsocket spends $2,301 below the state mean at $10,070 per pupil. Pawtucket also is below the state mean at $11,630.

The study focused on how the total per-pupil spending was allocated. Results from multiple regression indicated that spending on classroom instructional teaching tended to be associated with higher reading, writing, and math achievement, as measured by the NECAP exam. However, spending, on therapeutic support (primarily special education services), teacher support, operations, and other expenditures (including post-

retirement benefits and out-of-district special education placements) were either negatively associated with student achievement, or had no statistically significant association. By using school-level data from all Rhode Island elementary, middle, and high schools in the state, the study provides a comprehensive analysis of spending and achievement over the period.

The relationship between spending and achievement varied across the two model specifications that were estimated. In Model 1 pooled school-level observations were shown across years of data from 2005 through 2008. However, Model 1 results did not demonstrate whether this association was causal or related to how effective schools use their resources. It implied that simply placing more resources in the form of higher salaries and costly benefits for classroom teachers will not, in and of itself, improve student performance. The aggregate model did not measure teacher quality. However, it may be inferred that allocations to activities negatively or not associated with student performance (teacher support, therapeutic support, operations and leadership) divert resources away from classroom instruction, the one activity associated with student achievement.

Model 2 evaluated whether the difference in spending on various categories between years was associated with the difference in achievement between years. The model did not find an association between spending and achievement. By holding unobserved time-invariant factors (e.g. teacher quality) constant, this model was an attempt to better identify the association relationship between spending and achievement. It was anticipated that results from this model might highlight questions as to whether any specific pattern of spending, by itself, could improve student

achievement.Nonetheless, results from both models indicate that most forms of spending are not positively associated with student achievement which highlights likely inefficiency in spending across the state.

While the study was conducted at the school level, it is instructive to see the differences of spending priorities that take place at the district level. Table 5.1 compared the total per-pupil spending by districts with the amount allocated to instructional teaching. Most of the districts in the state are at or near the state mean with 53% of their per-pupil allocations dedicated to instructional teaching. Coventry (63.4%), Barrington (60%) and North Smithfield (60%) dedicated the highest proportion, and Woonsocket is the urban community with the highest ratio of 58.6%.

The only district of size which is considerably below the mean is Providence, at 45.4%. While allocating a low proportion to direct instruction, the district exceeds the state average in spending for therapeutic support, operations, leadership and other expenditures. Consequently, this study raises the question as to whether student performance in Providence is being held back by poor resource allocation.

School budgets include statutory expenditures. By law and regulation, facilities must be constructed and maintained, certification laws must be followed, and special education services must be provided. The allocations to teacher support, therapeutic support, operations and leadership are necessary, systemic expenditures, but must be evaluated carefully in light of the model results. It is not known whether these allocations are causal or the result of inefficient use, or influenced by other variables not included in the model. For example, effective school leadership has been shown to positively impact student achievement. It is unknown from the study results, however, whether ineffective

leadership is counterbalancing effective practicesor if a disproportionate level of spending is occurring for the function.

The cross sectional analysis in Model 1 shows a consistent relationship among the spending categories, both positive and negative, and reading, math and writing performance. The inconclusive results in the differencing Model 2 indicates that the association may not hold over time. To the extent this study can inform, most forms of spending do not appear to influence student performance. The one area that shows a positive relationship is the allocation to direct classroom instruction.The results of this study support earlier research that shows high performing district allocate a higher percentage of their resources to classroom instruction than their lower performing counterparts (Pan, Rudo, Schneider & Smith-Hansen, 2003).

Conversely, therapeutic support was negatively associated with reading, math and writing, and teacher support was negatively associated with math and writing. The negative association of therapeutic support may be attributed to selection bias. A large portion of these expenditures is for special education services. The students who receive special education are less likely to achieve proficiency due to the nature of their individual education plans (Alexander, Boyer, Brownson, Jennings, & Patrick, 2000).

The negative association of teacher support is of more interest. The expenditures for guidance, remedial staff and nurses, in theory, support students in order that they may be better prepared to achieve at higher levels. For example, to address the problem of low reading performance, the Rhode Island Board of Elementary and Secondary Education enacted regulation requiring districts to hire certified reading teachers to oversee personal reading plans (PLP) for underperforming students. Based on this study, it might have

been more effective to conduct staff development for classroom teachers who are positively associated with reading performance. Odden&Picus(2004) and Wenglinski(2002) found that these forms of expenditures, along with school operations and administration, were not associated with improved performance.

The study has implications for state-aid funding policy. The State of Rode Island adopted a funding formula in 2010 after two decades of level funding with percentage increases, regardless of enrollment, district performance, or budget allocation. The formula is based on enrollment, the community's ability to raise revenue for education, and weighted student need accounting for family income. The formula attempts to provide an equitable and adequate funding stream based on a "market-basket" of expenditures (teacher salary and benefits, guidance, operations, leadership, etc.). The formula does not dictate how resources are to be allocated.

The Uniform Chart of Accounts (UCOA) is a more detailed accounting than the In$ight program utilized in this study. By publicizing student test scores, funding, and UCOA data, RIDE makes the assumption that the public school committees and district administrations will make comparisons between neighboring or comparable districts and adjust resources accordingly.

The Rhode Island Basic Education Plan (BEP), developed in 1989, was based on the principle that given an acceptable level of inputs, such as staff, access to standard courses, libraries, textbooks, extra-curricular activities, students in the State would have the same opportunity to learn. The new BEP, adopted in 2010, is outcome-based. It asks whether students are meeting proficiency and graduating. Past disputes between a school district and their funding authorities centered on the input data of the old BEP. A

municipality might be ordered by the Court for example, to provide additional funds to offer French and Spanish as high school courses, or hire an additional librarian based on student enrollment. Under the new BEP, monetary disputes are more complex. A district must show that revenue is needed to improve student performance. This study will provide additional information regarding the effect on achievement that specific allocations have, and allow districts to prioritize their resources accordingly. Since there is a positive association between resources allocated to direct classroom instruction and student achievement, policy decisions that create funding streams diverted to other areas may be counter-productive.

Future research on the relationship between funding and achievement might consider more detailed examination of spending as independent variables as well as student growth as the dependent variable. By focusing by the growth patterns of individual student performance, better understanding could be gained as to how resources can affect the nature of instruction.

Table 5.1

Spending Allocation Means (expenditures per pupil)Rhode Island Districts, 2004-2008

District	Instructional Teachers ($)	Teacher Support ($)	Therapeutic Support ($)	Operations ($)	Other Expenditures ($)	Leadership ($)	Free/Reduced Lunch (%)
State	**6604**	**697**	**1041**	**1005**	**852**	**656**	**37.1**
Barrington	5946	716	327	856	516	409	3.2
Burriville	6163	628	629	1013	693	567	25.5
Bristol-Warren	6699	694	815	976	1155	717	22.9
Central Falls	7009	1043	1241	893	1194	667	85.2
Chariho	6663	630	787	966	1132	720	23.3
Coventry	6529	460	536	768	140	519	15.9
Cumberland	5381	625	951	836	600	431	17.9
E.Greenwich	6340	957	940	1221	387	861	4.9
E.Providence	6270	616	1191	835	1174	633	40.1
Exeter West Greenwich	6929	969	744	883	867	819	10.6
Foster	7269	660	843	945	206	522	14.2
Gloucester	6993	526	1603	949	427	568	13.5
Jamestown	8003	682	809	992	4379	617	7.1
Johnston	7179	558	1232	782	1575	632	21.1
Lincoln	7147	727	583	1022	478	589	13.9
Little Compton	7742	690	316	1267	3422	621	7.0
Middletown	7804	911	449	1312	995	616	16.2
Narragansett	8003	1362	1027	1255	546	959	9.6
Newport	7187	1302	1022	1074	1025	789	51.3

District	Instructional Teachers ($)	Teacher Support ($)	Therapeutic Support ($)	Operations ($)	Other Expenditures ($)	Leadership ($)	Free/Reduced Lunch (%)
N. Shorham	15486	442	751	2576	0	2445	8.4
North Kingstown	6011	784	1002	989	830	602	13.6
North Providence	7396	848	1073	989	833	714	27.2
North Smithfield	6040	611	623	703	640	475	
Pawtucket	6169	600	1530	722	847	466	64.0
Portsmouth	5418	812	526	753	1148	571	6.8
Providence	5965	579	1053	1287	1091	676	78.0
Scituate	5820	622	532	901	428	588	7.0
Smithfield	6425	590	780	867	545	653	8.4
S. Kingston	7526	884	1375	987	961	755	11.3
Tiverton	6747	1026	410	718	1301	501	15.2
Cranston	6591	678	667	949	611	716	25.6
Warwick	7322	742	1359	1155	957	636	22.1
Westerly	7295	529	1329	951	612	602	26.7
W. Warwick	7021	792	1167	878	1071	694	37.1
Woonsocket	5902	600	551	839	714	435	63.9

Table 5.2

The Proportion of Direct Instructional to Total Per Pupil Spending in Rhode Island Districts, 2004-2008.

District	Total Per Pupil Spending	Direct Instruction Spending	% of Direct Instruction
Providence	13141	5965	45.4
Jamestown	16744	8003	47.8
Little Compton	16099	7742	48.1
Gloucester	14187	6993	49.3
Foster	14166	7269	51.3
Newport	13790	7187	52.1
Central Falls	13463	7009	52.2
North Kingstown	11473	6011	52.4
Portsmouth	10305	5418	52.6
Johnston	13622	7179	52.7
Pawtucket	11630	6169	53.0
Bristol-Warren	12572	6699	53.2
State	**12371**	**6604**	**53.3**
W. Warwick	13171	7021	53.3
Narragansett	14947	8003	53.5
South Kingston	14058	7526	53.5
Exeter West Greenwich	12891	6929	53.7
East Greenwich	11752	6340	53.9

District	Total Per Pupil Spending	Direct Instruction Spending	% of Direct Instruction
East Providence	11545	6270	54.3
Westerly	13326	7295	54.7
Chariho	12152	6663	54.8
Warwick	13357	7322	54.8
Scituate	10551	5820	55.1
Cumberland	9720	5381	55.3
Burriville	10882	6163	56.6
Smithfield	11170	6425	57.5
Cranston	11349	6591	58.1
Middletown	13359	7804	58.4
North Providence	12657	7396	58.4
Tiverton	11529	6747	58.5
Woonsocket	10070	5902	58.6
Lincoln	12048	7147	59.3
Barrington	9909	5946	60.0
North Smithfield	10050	6040	60.0
Coventry	10293	6529	63.4
N. Shorham	24083	15486	64.3

APPENDIX A

Casewise Diagnostics

Dependent Variable: Reading Achievement

Case Number	Std. Residual	reading	Predicted Value	Residual
187	-5.083	22.22	67.0109	-44.78869
188	-3.408	38.46	68.4912	-30.02971
743	3.723	91.51	58.7011	32.80467
744	3.528	97.44	66.3553	31.08064
772	-3.069	38.24	65.2723	-27.03705
803	-4.098	19.75	55.8591	-36.10602

Dependent Variable: Math Achievement

Case Number	Std. Residual	math	Predicted Value	Residual
116	-3.173	16.04	49.7054	-33.66261
339	-3.011	16.92	48.8650	-31.94196
414	3.342	45.95	10.4938	35.45726
441	3.125	74.00	40.8446	33.15539
443	3.333	70.00	34.6445	35.35553
484	-3.371	19.52	55.2823	-35.76172
743	-3.332	40.23	75.5729	-35.34302
763	-4.185	3.45	47.8427	-44.39438
764	-3.954	4.35	46.2876	-41.93980
804	-3.217	9.38	43.4971	-34.12214
812	-3.533	10.29	47.7694	-37.47532
856	-3.593	30.24	68.3643	-38.12038
912	-3.450	23.81	60.4081	-36.59860
1163	-3.392	18.83	54.8186	-35.98455

Dependent Variable: Writing Achievement

Case Number	Std. Residual	writing	Predicted Value	Residual
374	-4.780	.00	54.7639	-54.76389
417	3.338	41.00	2.7608	38.23923
487	-4.288	23.26	72.3865	-49.13072
937	3.701	94.00	51.5933	42.40673

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