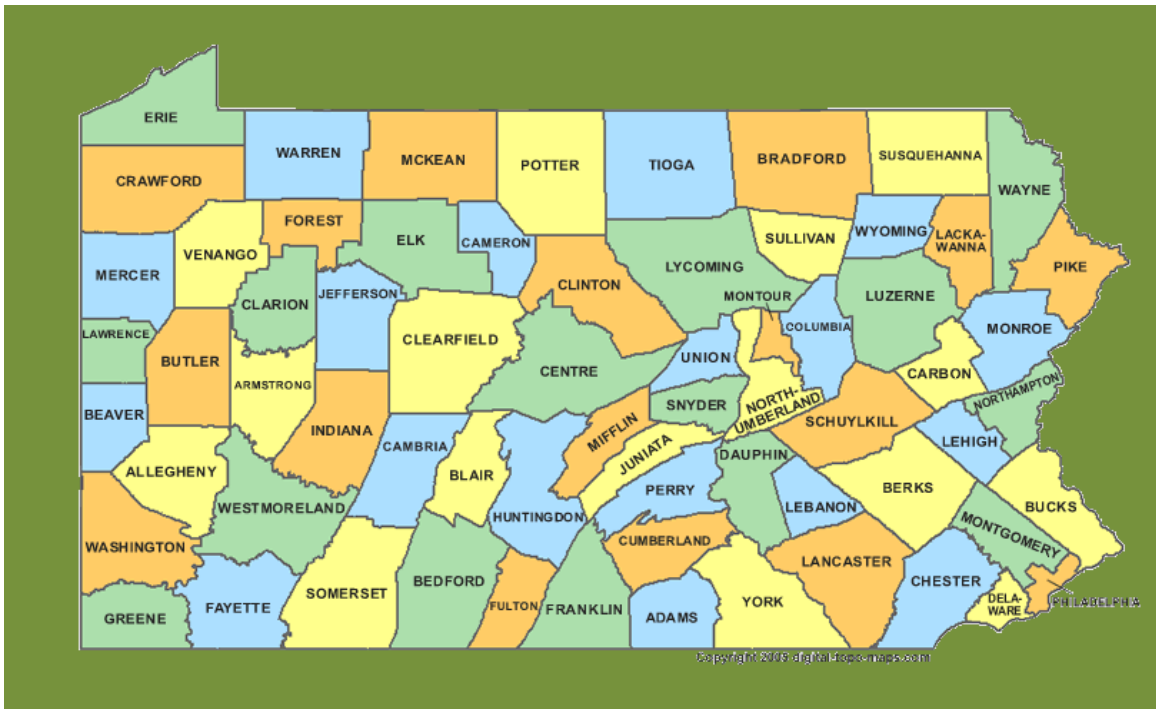
THE FINANCIAL AND NON-FINANCIAL FACTORS ASSOCIATED WITH 11TH GRADE STUDENT ACADEMIC PROFICIENCY IN MATH AND READING IN PENNSYLVANIA



F. Joseph Merlino, PI, The Math Science Partnership of Greater Philadelphia
R. Lorraine Bernotsky, Ph.D., West Chester University of Pennsylvania
Jill Feldman, Ph.D., Research for Better Schools
Ning Rui, M.S., Research for Better Schools

June 2009

Support for the research reported in this paper was provided by the Math Science Partnership of Greater Philadelphia (MSPGP) with funding from the National Science Foundation. (Award Number: 0314806) Opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the National Science Foundation, La Salle University, West Chester University or Research for Better Schools.

161 Washington Street, Suite 1040, Conshohocken, Pa 19428 610-825-5644

Table of Contents

Disclaimer: Please note that this paper is presented in a non-technical format for general readership. The Math Science Partnership of Greater Philadelphia is able to provide a technical briefing for statisticians who wish further clarification or discussion of the analytical methodologies applied in this study.

Overview of Findings
An analysis of publicly available data for the 498 school districts in Pennsylvania reveals that:

- 11th grade PSSA performance in math and reading is slightly *negatively* associated with total district expenditures per student, which ranged between $ 8,168 - $29,512 per student, while holding other contextual variables constant.

- 11th grade PSSA performance in math and reading is not significantly associated with instructional expenditures per student, which ranged between $ 4,276 - $11,010 per student, with less than 1 percent of variation in district-level PSSA proficiency attributable to instructional expenditures.

- 11th grade PSSA performance in math and reading is positively and strongly associated with the percentage of community residents with a bachelor's degree.
- The percentage of minority students in a district has a moderate to strong negative correlation with the percentage of students scoring advanced or proficient on the 11th grade PSSA test.
- The percentage of students in low-income households in a district has a moderate to strong negative correlation with the percentage of students scoring advanced or proficient on the 11th grade PSSA test.
- These patterns remain even when Pittsburgh and Philadelphia districts are excluded from the analysis, suggesting that these are consistent patterns across the state.
- A more in depth study of 46 districts in PA and NJ suggests that there is a moderate positive relationship between higher-level math course taking and 11th grade PSSA test performance.

Previous work by the Math Science Partnership of Greater Philadelphia (MSPGP) reveals several impediments that may account for why we did not find an association between aggregate per pupil instruction expenditures in a district and the percentage of 11th grade PSSA math and reading proficiency. These impediments include:

- high turnover of school district administrators
- inconsistency of policy and its implementation
- insufficient external monitoring and technical support
- disorganized data management, analysis and translation to action
- poor communication vertically and horizontally within and between schools and the district
- absence of coherent and aligned k-12 curricula
- system incoherence
- lack of teacher staff capacity

Background for the Study

The Math Science Partnership (MSP) program was established under the National Science Foundation Authorization Act of 2002.[1] With over 80 awards granted since 2002, the MSP program is a federal research and development effort to improve math and science education in K-12 schools by involving higher education, especially disciplinary faculty in math, sciences, and engineering. The MSPs have three specific goals[2]:

- Ensuring that all students have access to, are prepared for, and are encouraged to participate and succeed in challenging and advanced mathematics and science courses;
- Enhancing the quality, quantity, and diversity of the K-12 mathematics and science teacher workforce; and
- Developing evidence-based outcomes that contribute to our understanding of how students effectively learn mathematics and science.

In 2003, the NSF awarded a $12.5 million grant to La Salle University to establish the Math Science Partnership of Greater Philadelphia (MSPGP). Now in its sixth year, MSPGP is comprised of about 125 secondary schools in 46 Pennsylvania and New Jersey districts[3], the science, mathematics, and education faculties of 13 colleges and universities, and the resources of a number of non-profit organizations. A key feature of the MSP program is the use of data and evidence. Beginning with the 2003-04 academic year, the MSPGP was required to collect detailed course enrollment and passing information on all its participating high schools – data sets not normally collected at the district or state level. Once the MSPGP collected math and science course enrollment data for each high school, we wrote a "School Math and Science Status Report" which also included a variety of publicly available district and community census information. For example, we included racial and ethnic information, percentage of students receiving free and reduced lunch, percentage of the community with a bachelor's degree as well as district educational expenditures.

This study was originally intended to explore the relationship between course enrollment and passing rates and performance on the Pennsylvania[4] and New Jersey 11thgrade state math assessments within the MSPGP's 46 districts. PSSA performance includes the percentage of students scoring advanced, proficient, basic, and below basic for each district. Since we had already obtained other "contextual" variables from public sources in order to write the School Math and Science Status Reports we used these data to run a series of stepwise multiple regression analyses. The regression coefficients allowed us to examine the unique effect of each variable while holding other variables constant. For both the analysis of the 46 MSPGP districts and the state-wide study, we performed a forward stepwise linear regression with percentage of 11th graders scoring advanced, percentage of 11th graders scoring proficient or above, and percentage of 11th graders scoring below basic on PSSA as the dependent variables respectively, and the following variables as potential predictors:

- Percentage of economically disadvantaged students
- Percentage of white students
- Percentage of community residents with a bachelor's degree
- Percentage of low-income households in the community

[1] (P.L. 107-368), December 19, 2002.

[2] http://www.nsf.gov/pubs/2009/nsf09507/nsf09507.htm.

[3] See Appendix for the list of MSPGP partner districts.

[4] Pennsylvania adopted academic standards for Reading, Writing, Speaking and Listening and Mathematics in 1999. The annual Pennsylvania System of School Assessment (PSSA) is a standards-based criterion-referenced assessment adopted to measure students' attainment of the academic standards. All students in grades 3 through 8 and grade 11 are assessed in reading and math and students in grades 5, 8 and 11 are also assessed in writing. (Pennsylvania Department of Education, 2009).

- Revenue per student (in $1,000)
- Total pupil expenditure (in $1,000)
- Instructional expenditure per student (in $1,000)

For the 46 MSPGP district analysis, we also considered the percentage of 11th graders who took Level 3 college prep or above math courses, and the percentage of 11th graders who took Level 4 or above college prep math courses.

As noted above, we focused on 11th grade proficiency on state tests as the outcome variable. Since the passage of the No Child Left Behind Act (NCLB), public schools and districts have increasingly strived to do well on such tests because they have served as the focal point of accountability. In both Pennsylvania and New Jersey, students' 11th grade proficiency scores are used to assess high school performance, although controversy remains as to the appropriateness of using mean absolute proficiency percentages on state tests to assess the performance of all schools (Kim & Sunderman, 2005). Schools that fail to make "adequate yearly progress" (AYP) for two consecutive years are targeted as needing improvement. If the failure persists, these schools are subject to increasingly more severe sanctions, including closure.

Despite the focus on AYP, from a national perspective, Pennsylvania's student achievement is generally above average, as evidenced by its National Assessment of Educational Progress (NAEP) math score for 8th grade (286) in 2007, which was 6 points higher than that of the nation's public schools. Of the 52 states and other jurisdictions that participated in the 2007 8th grade assessment, students' average scale score in Pennsylvania was higher than those in 25 jurisdictions, not significantly different from those in 21 jurisdictions, and lower than those in 5 jurisdictions. The percentage of students in Pennsylvania who performed at or above the NAEP *Proficient* level was 38 percent in 2007. This percentage was greater than that in 2005 (31 percent) and in 1990 (17 percent) (USDOE, 2007). Nonetheless, it has proven difficult to make substantial gains in high school 11th grade PSSA test scores. Currently 12th grade NAEP is not given in Pennsylvania.

Our initial results examining the 46 MSPGP partner districts showed an unexpectedly strong correlation between the percentage of people in the community with a bachelor's degree and percentage of 11th grade students scoring advanced (r= .79) and those scoring proficient or above (r= .55) in the state math test. Percentage of low-income households in the community also showed a strong negative correlation with percentage of 11th grade students scoring advanced (r= -.56). We further detected a modest correlation between 11th graders who are advanced in math and the percentage of 11th graders who have taken Level 3 or above math course work (r= .47). But when we looked at the association between 11th graders who scored advanced in math and district instructional expenditures per pupil we found nearly zero correlation (r= .02). Indeed, when we did a multiple regression analysis, we saw a slightly *negative* correlation between the percentage of 11th graders advanced in math and the expenditure or revenue per student; that is, the more that was spent, the *worse* students performed, albeit slightly. However, we did find a weak positive correlation between institutional expenditures per student and percentage proficient or above in 11th grade math (r = .19) in our sample of 46 districts.

Inasmuch as our sample was from the southeastern Pennsylvania suburban area and parts of southern New Jersey, we wondered if these same relationships would be true if we looked at all of Pennsylvania's 498 school districts. While we only had course enrollment and passing data on the MSPGP's 46 school districts, as neither Pennsylvania nor New Jersey collect such data, we nonetheless could compile information about other contextual variables, such as the amount of instructional expenditure per pupil in each district, SES, and the percentage of people in the community with a bachelor's degree. Using publicly available data, we looked at the association of

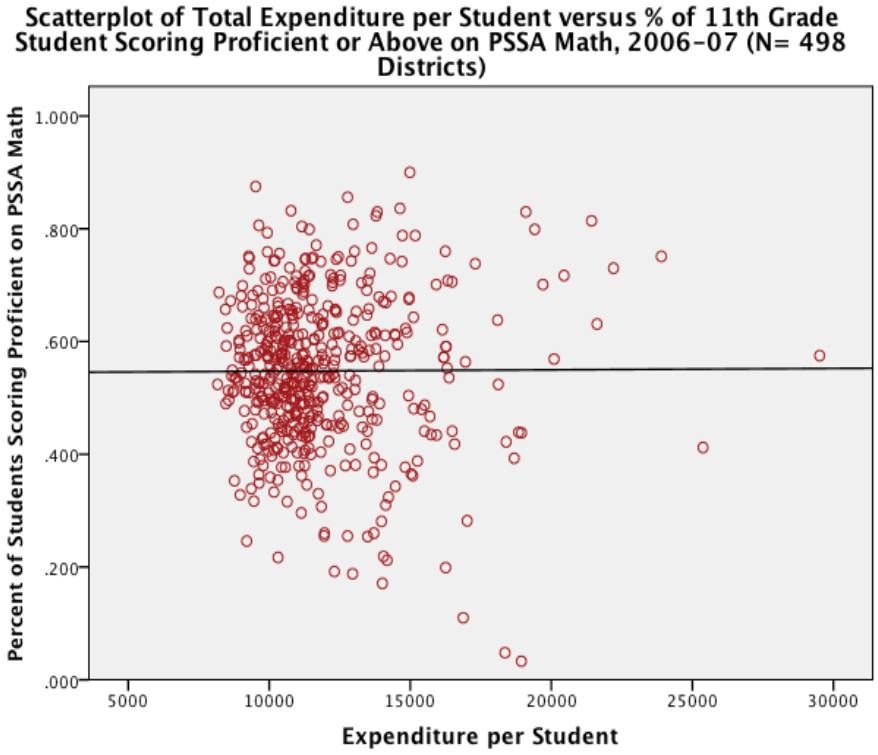
11th grade math and reading PSSA percentage proficient for each district in Pennsylvania with the following "contextual" factors with a district:

- Percentage of white students
- Percentage of economically disadvantaged students
- Percentage of bachelor's degree holders in the community
- Percentage of low-income households in the community
- Total pupil expenditure in the district
- Instructional expenditure per student in the district

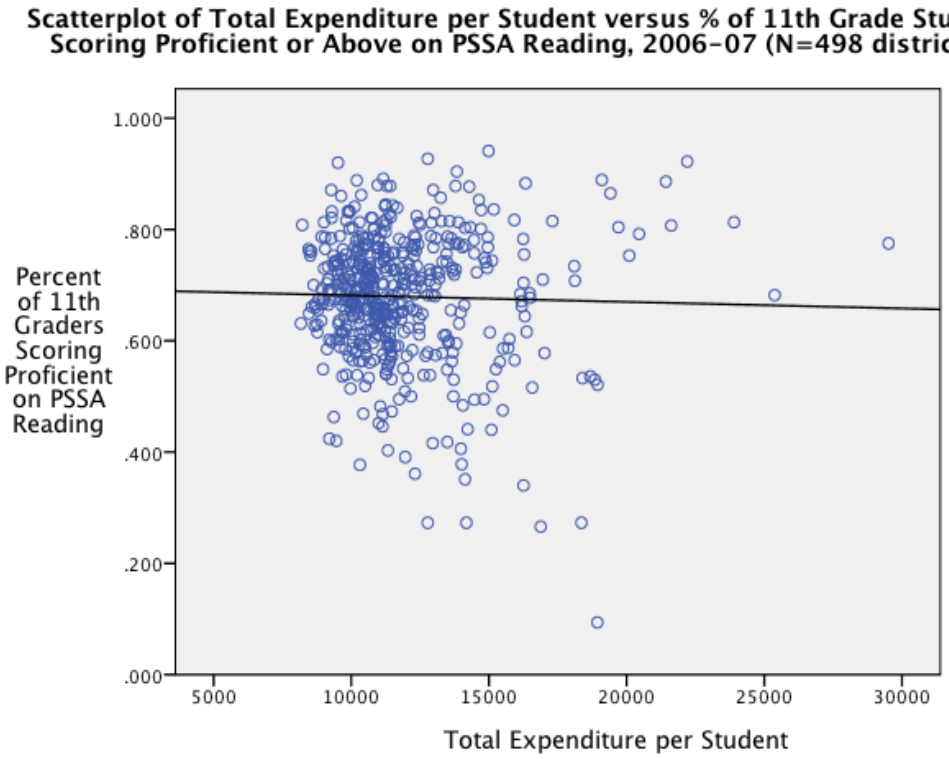
Summary of Findings

An analysis of publicly available data for the 498 school districts in Pennsylvania reveals that:

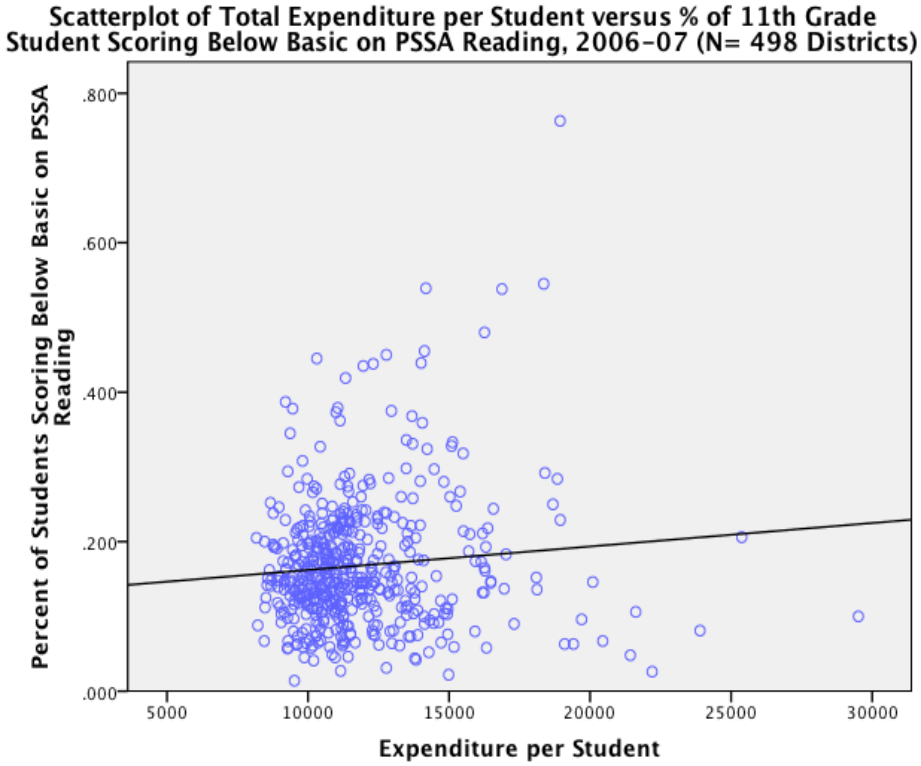
1. Total expenditure per student has a near zero correlation with 11th grade PSSA proficiency in math (r= .005)[5] and a slightly negative correlation with 11th grade PSSA proficiency in reading (r= -.027); the total expenditure ranges from $ 8,168 to $29,512 per student.



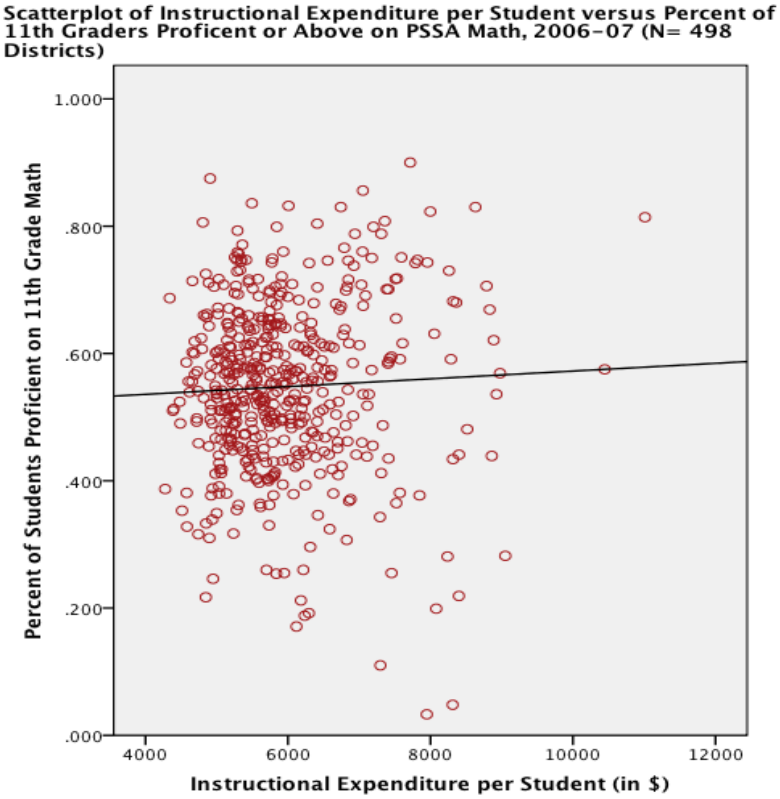
[5] All of the findings in this section report the Pearson Product-Moment correlation coefficient.

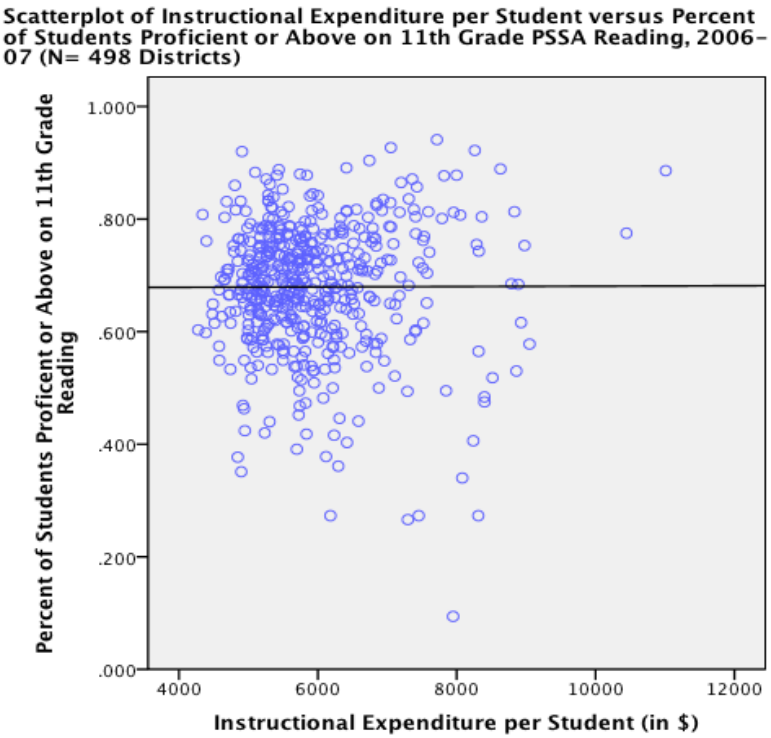


2. Total expenditure per student has a small positive correlation with percentage of students Below Basic on both 11th grade PSSA math (r= .053) and reading tests (r= .094).



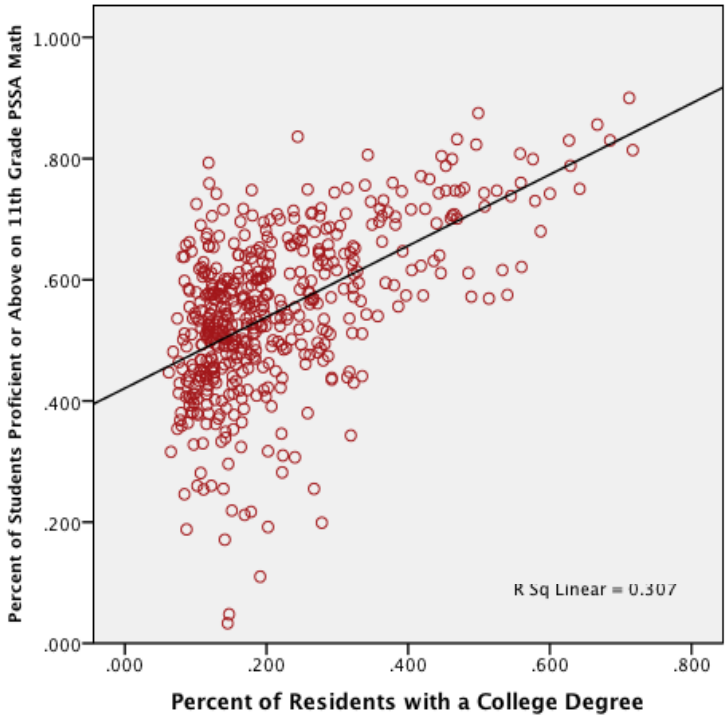
3. The magnitude of the relationship between instructional expenditure per pupil within a district and student proficiency on 11th grade PSSA is very small for both 11th grade PSSA math (r= .044) and reading tests (r= .003) as shown in the scatterplots below.



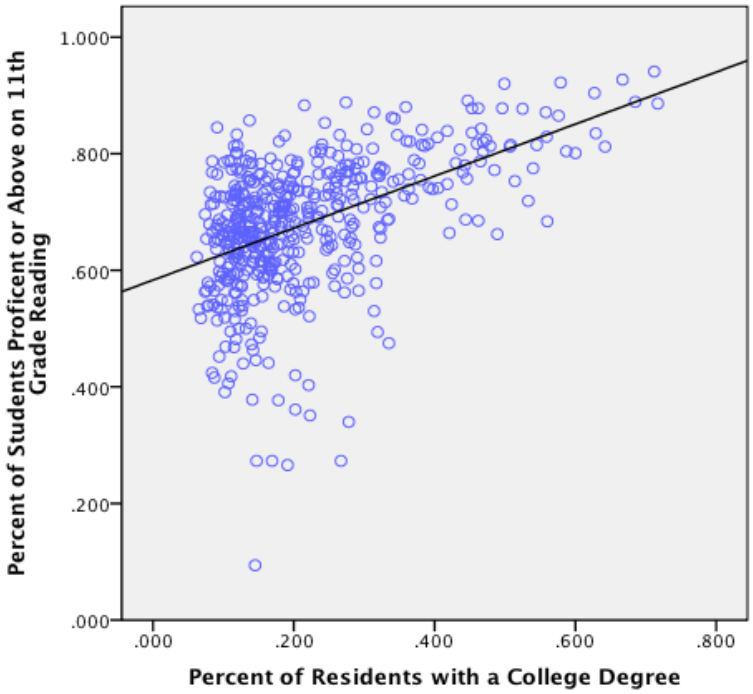


4. The percentage of community residents with a bachelor's degree has a moderate to strong positive correlation with 11th grade PSSA performance in math (r= .554) and reading (r= .486).

Scatterplot of Percent of Residents with a College Degree versus Percent of Students Proficent or Above on 11th Grade PSSA Math, 2006-07 (N= 498 Districts)



Scatterplot of Percent of Residents with a College Degree versus Percent of Students Proficient or Above on 11th Grade PSSA Reading, 2006-07 (N= 498 Districts)



5. The percentage of minority students in a district has a moderate negative correlation with the percentage of students scoring advanced or proficient on the 11th grade PSSA math (r= -.379) and reading (r= -.475) tests.

6. The percentage of students in low-income households in a district has a strong negative correlation with the percentage of students scoring advanced or proficient on the 11th grade PSSA math (r= -.566) and reading (r= -.520) tests. [6]

Discussion

Policymakers are interested in finding ways to close the achievement gap between student groups as well as raise the overall level of student achievement. Given the explosive growth of technology and global competition, there is understandable urgency to better prepare young people for college and career success. However, at the high school level, achieving these goals has been elusive in Pennsylvania. Student PSSA 11th grade performance in math over the past 8 years has improved only slightly from 49% to 56% and remained virtually flat in reading. Spending more money in the aggregate particularly in the face of large differences in pupil expenditures and closing the per pupil expenditure gap would seem like a prudent educational as well as long-term economic development policy. Yet, the results of our study show that aggregate district instructional expenditures which ranged between $ 4,276 - $11,010 per student are, in fact, not associated with 11th grade PSSA proficiency in either math or reading, at least in 2006-07. The correlation is near zero and in some cases even slightly negative.

While our findings are admittedly only a snapshot of the relationship between per pupil expenditures and 11th grade PSSA scores, other studies have examined whether student achievement rose after considerable added public investment. **The results do not support the assumption that increased spending necessarily improves student performance.** In New Jersey, Coate and VanderHoff (1999) found no relationship between additional district expenditures and high school student achievement before and after the 1990 Abbott II decision (which resulted in substantially more state funds to poorer school districts). Ritter and Lauver (2003) analyzed the same data and concluded that the higher funding received by Abbott districts did not seem to improve student outcomes. Simple resources are likely to be a necessary but not sufficient condition for improved teaching and learning outcomes (Grubb, 2008; Yeh, 2007). Previous studies show that adequacy litigation can play a limited role (as evidenced by small effect size) in a comprehensive education reform strategy (Glenn, 2009). Peevely and Ray (2001) found that students in the school districts that prevailed in Tennessee's school-finance litigation showed no consistent pattern of greater gains than students in the rest of the state, despite the infusion of funding.

Such findings leave policymakers in somewhat of a conundrum. There is general agreement that raising student achievement and improving high school graduation rates are critical policy goals for individuals' personal success and the long term economic vitality of the Commonwealth. While the data presented in this paper suggest that increasing aggregate educational expenditures will not likely yield increased 11th grade PSSA proficiencies, such an interpretation does not capture the possible effects of programs that have been implemented. The cautionary note here is that it is entirely possible that the underlying relationship between instructional expenditures and student achievement has been changing due to other factors and initiatives. But there are not reliably consistent

[6] The analysis for these findings includes the school districts of Philadelphia and Pittsburgh. However, it should be noted that the patterns in all of these findings remain even when Pittsburgh and Philadelphia districts are excluded from the analysis.

data sources at present to examine these possibilities. With this in mind, what alternatives are available to policymakers?

One alternative could be to question whether the 11th grade PSSA test truly measures student achievement and the totality of value high schools contribute to a student's development. Perhaps measures of other values of high schools to student development in addition to the 11th grade PSSA tests would produce a positive correlation with aggregate educational expenditures. That inquiry, however, is beyond the scope of this study and doesn't address the present use of PSSA scores to approximate student achievement in Pennsylvania.

A second alternative is to expand and refine the per pupil expenditure calculations in this study in the hopes of showing a positive correlation between specific per pupil expenditures and specific desirable high school outcomes. For example, we did not assign weights to the expenditures based on geographical differences in the cost of living. Such differences would manifest themselves in teacher salary scales, hence, greater expenditures per pupil in some regions may be more an effect of cost of living than specific instructional interventions. In addition, our study did not look at *changes* in high school outcomes over time as a function of *changes* in per pupil expenditures over time. Also we did not correlate high school per pupil expenditures with other kinds of high school outcomes beyond standardized test performance. Perhaps these refinements would yield different results. Perhaps not. Relevant literature does not give us hope that we would find anything materially different in the results (Rebell , 2006).

A third alternative for policymakers is to focus on specific areas where increased expenditures are likely to prove fruitful and then sponsor independent research to learn whether such investments produced the expected outcomes and if so, how much of an effect resulted and at what cost? For example, studies of Kindergarteners have shown that children from families with low socio-economic status typically enter school *already* far behind their more advantaged counterparts. This achievement gap usually persists throughout their K-12 careers (Lee and Burkham, 2002). To counter this initial disadvantage, Southeast Delco School District with its diverse racial ethnic student population, recently established an all day Kindergarten Center that focused on bringing all students up to grade level. This past year, 82 percent of students entered first grade on grade level. Thus, from a strategic standpoint, investing in preschool and Kindergarten at least in theory could make sense.

In our study of 20 middle schools in Pennsylvania and New Jersey that adopted an inquiry-based math program coupled with substantial teacher professional development (180 hours), we found some schools raising their 8th grade PSSA and HSPA scores by 34% points as compared to comparably matched schools. However, some schools actually *declined* by the same amount when matched against similar schools. What made the difference? Based on 700 visits to classrooms and schools, and dozens of administrative interviews, we found that the differences in 8th grade math student achievement on the PSSA was related to the degree of instructional leadership displayed by the principal in getting teachers to accept and implement the new math programs as they were designed and initially tested. Indeed, the research literature has accumulated strong evidence as to the critical role that principal leadership plays in teacher practice and the learning environments (Leithwood and Jantzi, 2000; Hallinger, 2000; Gronn, 2002). Thus, investing in principal leadership development across the board as is the case with Pennsylvania's Inspired Leadership program (PIL) could prove very cost effective.

In sum, our experience and our analysis of the data suggests that the issue is not simply *how much* money is made available to districts so much as it is *how* districts make use of the money that is made available to them.

Impediments to Improvement

For the past 6 years, the MSPGP has spent nearly $12.5 million aimed at increasing math and science achievement and teacher preparation with a set of secondary schools. In our work, we found eight structural impediments to system improvement or whether any particular programmatic initiative will be successfully implemented. Moreover, we suspect these impediments may be related to our findings regarding the lack of relationship between increased aggregate educational spending and 11th grade PSSA performance. These impediments include:

1. High turnover of school district administrators
    a. We have noted a high level of instability in school district administration from superintendents to principals and curriculum supervisors.
    b. Even when senior leaders are committed to academic initiatives, this inherent instability and the general lack of systemic approach to district organization and goal alignment severely limits the potential for success.
2. Inconsistent policy and its implementation
    a. In the midst of school board, administrative and teacher turnover, one of the major determinants of actualizing school and student improvement is whether there is consistency of policy and fidelity of its implementation.
    b. If a district has goals and policies that are deeply and consistently embedded throughout the system, then changes in administrators and teachers are less likely to have a significant effect.
3. Insufficient external monitoring and technical support
    a. The Pennsylvania Department of Education requires districts to submit various planning documents: Strategic, School Improvement, Teacher Induction, Technology, Special Education, Professional Development and Finance.
    b. PDE does not have the field-based capacity to work with districts on a regular basis to review these plans for content, consistency or practicality.
4. Disorganized data management, analysis and translation to action
    a. Obtaining and processing student achievement and enrollment data from our district partners in a usable and timely matter presents significant difficulties.
    b. This is not due to any reluctance by administrators to honor data requests, but rather from their districts' lack of organizational capacity to do so.
5. Poor communication vertically and horizontally within and between schools and the district
    a. District reports or performance data are not shared vertically or horizontally. At times all the stakeholders in initiatives are not engaged until it is too late for them to have meaningful input.
    b. In some districts there are no opportunities for comfortable or collegial discussions of issues, ideas or questions that emerge at different levels of district hierarchies or across schools.
6. Absence of coherent and aligned k-12 curricula
    a. This is often characterized by the lack of internal capacity for its development in each of the content areas.
    b. There is not enough time allowed for the implementation of new curricula prior to expectations of observable outcomes.
    c. Fidelity of implementation of programs requires buy-in at all levels of the school hierarchy, and it requires training of supervisors so that classroom observations and evaluations are based on pedagogical strategies that are congruent with the curriculum.

7. System incoherence
    a. Some districts have too many initiatives that are not well coordinated and are often working at cross-purposes.
    b. Several districts start an initiative one year and develop plans to continue that for several years because full implementation takes multiple years, but then the next year a new initiative or directive takes its place.
8. Lack of teacher staff capacity
    a. Some districts lack effective protocols for improving the hiring and mentoring of new teachers.
    b. Some districts lack effective plans for effective, sustained, quality professional development.

Recommendations: A New Way Forward

Overcoming these impediments is a daunting task. It requires a new way of thinking about the challenges associated with increasing student literacy and achievement. We recommend policy makers should first consider the infrastructure that would be necessary to actually begin assessing in reliable and measurable ways the effects of the ways that funding is used to increase student performance.

Specific recommendations to address these impediments and to increase 11th grade proficiency include:

- Creating statewide and regional infrastructures for school improvement comprised of members from the Pennsylvania Department of Education, Intermediate Units, K-12 schools, community colleges and four year public and private higher education institutions, nonprofit research and educational organizational and economic development and workforce entities.
- Encouraging school planning that is rooted in site-based data and research that supports the implementation of Standards Aligned Systems.
- Enabling districts to create action plans based on a variety of process and performance indicators that are relevant to district action plans.
- Increasing the knowledge, understanding and use of existing research for effective district planning and statewide policymaking by expanding the research base on educational proven programs, policies and practices.
- Providing research design assistance to local districts to assist them in developing a culture of evidence as it relates to new and existing program interventions.
- Brokering collaborations and partnerships to achieve any of the above goals especially in terms of linking the Pennsylvania Department of Education, K-12 schools, community colleges and four-year public and private higher education institutions and the workforce.

The Commonwealth of Pennsylvania is uniquely suited to tackle the complex problem of educational reform because it has university, non-profit, and economic and workforce development centers of expertise across the state that sit as untapped resources. Mobilizing and resourcing these centers could contribute significantly to the science and art of school improvement as policymakers and educational leaders face the challenges of preparing students for the 21st century. Finally, leveraging the expertise available in the state against the backdrop of the economic challenges facing the Commonwealth could provide useful and timely direction for those charged with making education policy and funding decisions.

Technical Notes

Design

This study relies primarily on district-level demographic and PSSA performance data for the 2006-07 school year. PSSA performance includes percentages of students scoring advanced, proficient, basic, and below basic for each district. For those thirteen MSPGP districts that are located in New Jersey, New Jersey System of School Assessment (HSPA) data were used as achievement variables. District and community demographic data were retrieved from multiple sources, including the school report card profiles at the state department of education website as well as www.schoolmatters.com and www.schooldatadirect.org.

The study was divided into two phases. During the first phase, we analyzed the relationships between district performance on the state tests and a series of school and community demographic and contextual factors, using data for the 46 MSPGP districts. Specifically, the analysis focused on the relationship between percentage of advanced math course completion and student math proficiency during the 2006-07 school year. During the second phase, we extended the analysis to the entire state, including 498 secondary school districts. Since information on advanced course completion is not available on all the districts in the state, we focused on the specific roles of demographic, socioeconomic, and financial factors in explaining student academic proficiency in math and reading. Forward stepwise linear regression analysis, a standard statistical approach in social science, was applied to both sets of analyses so that the unique contribution of each factor could be determined while controlling for other variables. Variables with p-value of less than .15 were added to the model and variables with p-values greater than .15 were removed from the model. Tolerance index was used to control for multicollinearity. Predictors with tolerance values less than .30 suggest multicollinearity and were removed from the model.

Descriptive Statistics

Table 1 presents the descriptive statistics of the key variables for the Phase I analysis. As shown in the table, there is a high degree of variation in both demographic characteristics and academic proficiency across districts although Pennsylvania as a whole has a proficiency level above the national average. The variation exists even across most of the suburban districts, bearing in mind that Philadelphia City School District is not a partner district of MSPGP. Therefore, it is worth the effort to investigate what factors account for the variations in student achievement across districts.

Table 1. Descriptive Statistics of Key Variables in Phase I (MSPGP) Analysis.

Variable	N	Mean	SD	Minimum	Maximum
% of 11th graders scoring Proficient and Above on state math test	44	60.9%	15.7%	25.5%	89.3%
% of 11th graders scoring Advanced on state math test	40	24.67%	12.6%	3.2%	64.7%
% of 11th graders enrolled in Level 3 or above math courses	38	68.7%	22.8%	22.9%	100%
% of 11th graders enrolled in Level 4 or above math courses	39	33.9%	20.6%	1.7%	95.8%
% of white students	44	71.6%	26.3%	2.2%	98.2%
% of economically disadvantaged students	45	23.2%	20.4%	1.1%	73.3%

Variable	N	Mean	SD	Minimum	Maximum
% of college degree holders in the community	44	30.2%	13.2%	9.5%	68.5%
% low-income families in the community	43	42.3%	9.6%	16.4%	66.0%
Total per pupil expenditure	45	$14,669	$ 3,364	$9,454	$28,671
Instructional expenditure per student	45	7,201	$1,312	$5,149	$11,270
District revenue on per student basis	45	$14,474	$2,515	$9,468	$20,391

Table 2 summarizes the distribution of key independent and dependent variables for the Phase II analysis, which involves 498 secondary districts in Pennsylvania.

Table 2. Descriptive Statistics of Key Variables in Phase II Analysis.

Variable	N	Mean	SD	Minimum	Maximum
% of 11th graders scoring Proficient and Above on PSSA Math	498	54.77%	13.28%	3.30%	90.00%
% of 11th graders scoring Below Basic on PSSA Math	498	24.40%	11.03%	3.10%	86.40%
% of 11th graders scoring Proficient and Above on PSSA Reading	498	67.94%	11.48%	9.40%	94.10%
% of 11th graders scoring Below Basic on PSSA Reading	498	16.80%	8.66%	1.40%	76.30%
% of white students	498	89.33%	16.97%	0.00%	100.00%
% low-income families in the community	498	55.62%	13.00%	18.10%	80.30%
Total per pupil expenditure	498	$11,836	$2,605	$8,168	$29,512
Instructional expenditure per student	498	$5,942	$967	$4,276	$11,010
District revenue on per student basis	498	$11,957	$1,934	$8,531	$21,918
% of economically disadvantaged students	498	26.53%	15.49%	0.98%	94.08%
% of college degree holders in the community	498	21.54%	12.51%	6.20%	71.70%

Charts 1 through 4 below present the state-specific performance on NAEP 4th grade and 8th grade math and reading tests.[7] As shown in the charts, the state-level improvement on math achievement is more pronounced than that on reading achievement in recent years (2003-2007). Chart 5 provides a snapshot of the overall student performance on 11th grade PSSA math, reading, and science tests during 2006-07. In comparison with math and reading achievement, Pennsylvania's high school students did much more poorly on science, as evidenced by merely 37% of students reaching proficiency on science versus 55% on math and 67% on reading.

[7] Data for Charts 1-4 were retrieved from NAEP website at http://nces.ed.gov/nationsreportcard/states/profile.asp. Data for Chart 5 was retrieved from PA Department of Education website: http://www.pde.state.pa.us/a_and_t/cwp/view.asp?A=3&Q=129181.

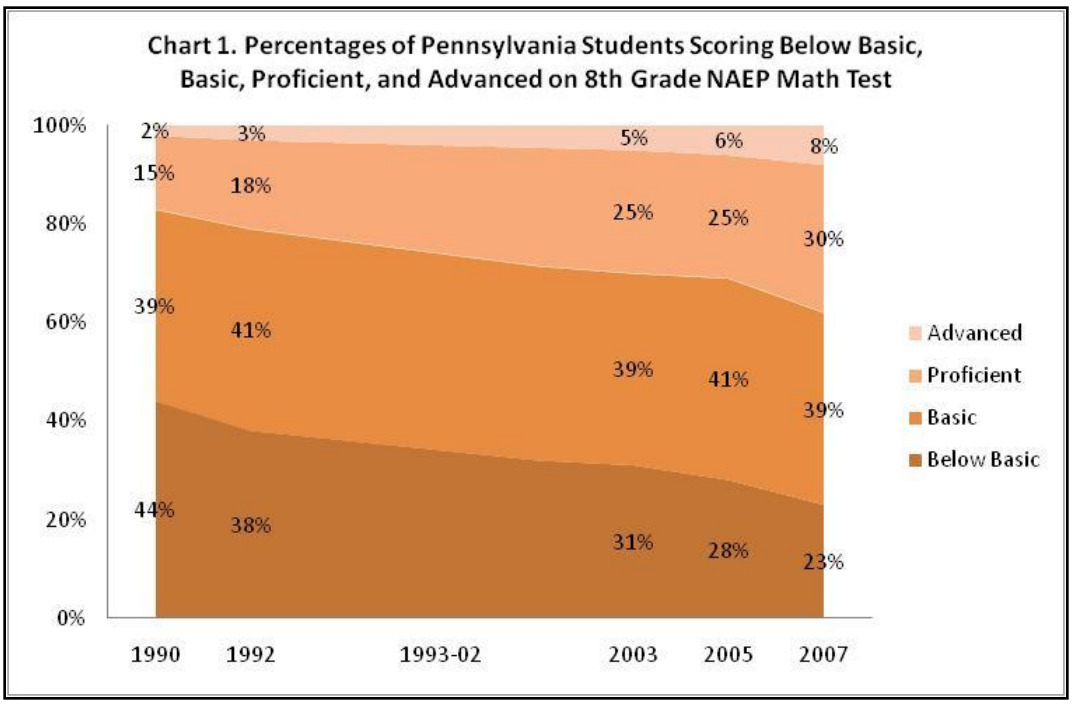


Chart 1. Percentages of Pennsylvania Students Scoring Below Basic, Basic, Proficient, and Advanced on 8th Grade NAEP Math Test
100%
80%
60%
40%
20%
0%
2%
3%
5%
6%
8%
15%
18%
25%
25%
30%
39%
41%
39%
41%
39%
44%
38%
31%
28%
23%
1990
1992
1993-02
2003
2005
2007
Advanced
Proficient
Basic
Below Basic

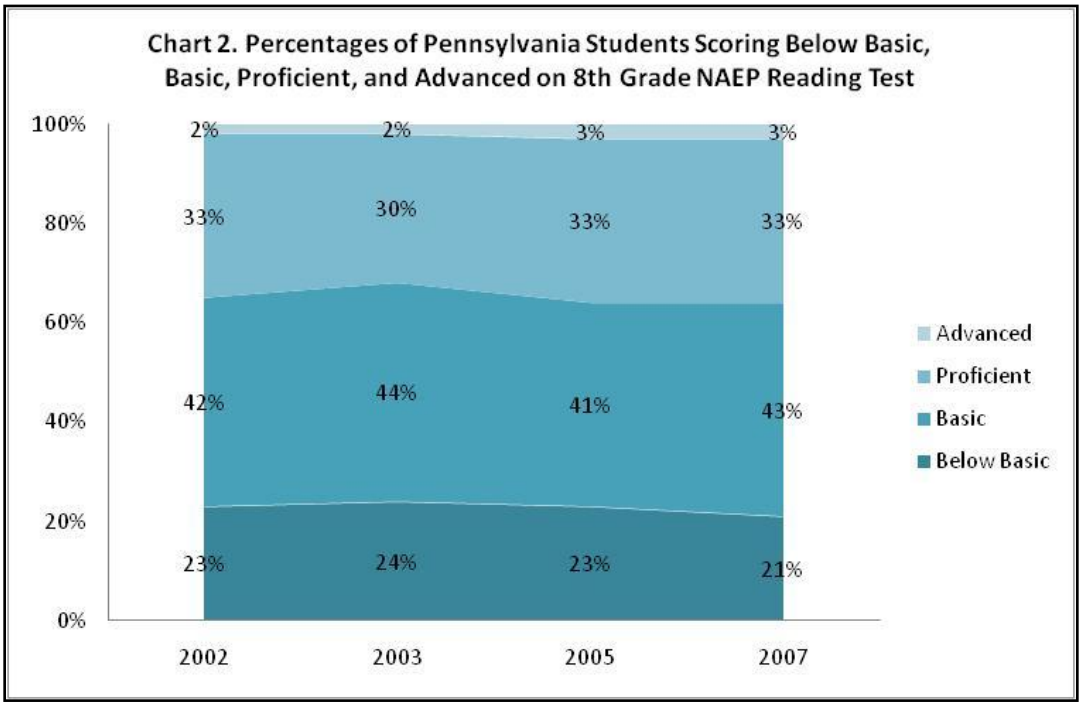


Chart 2. Percentages of Pennsylvania Students Scoring Below Basic, Basic, Proficient, and Advanced on 8th Grade NAEP Reading Test
100%
80%
60%
40%
20%
0%
2%
2%
3%
3%
33%
30%
33%
33%
42%
44%
41%
43%
23%
24%
23%
21%
2002
2003
2005
2007
Advanced
Proficient
Basic
Below Basic

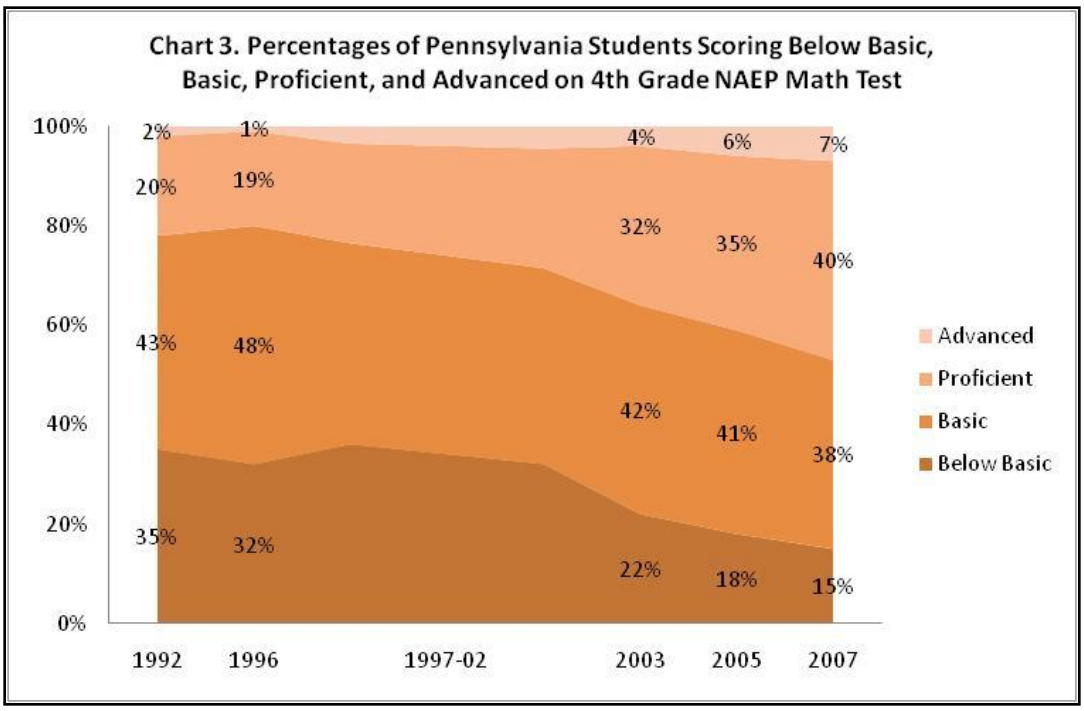


Chart 3. Percentages of Pennsylvania Students Scoring Below Basic, Basic, Proficient, and Advanced on 4th Grade NAEP Math Test
100%
80%
60%
40%
20%
0%
2%
1%
4%
6%
7%
20%
19%
32%
35%
40%
43%
48%
42%
41%
38%
35%
32%
22%
18%
15%
1992
1996
1997-02
2003
2005
2007
Advanced
Proficient
Basic
Below Basic

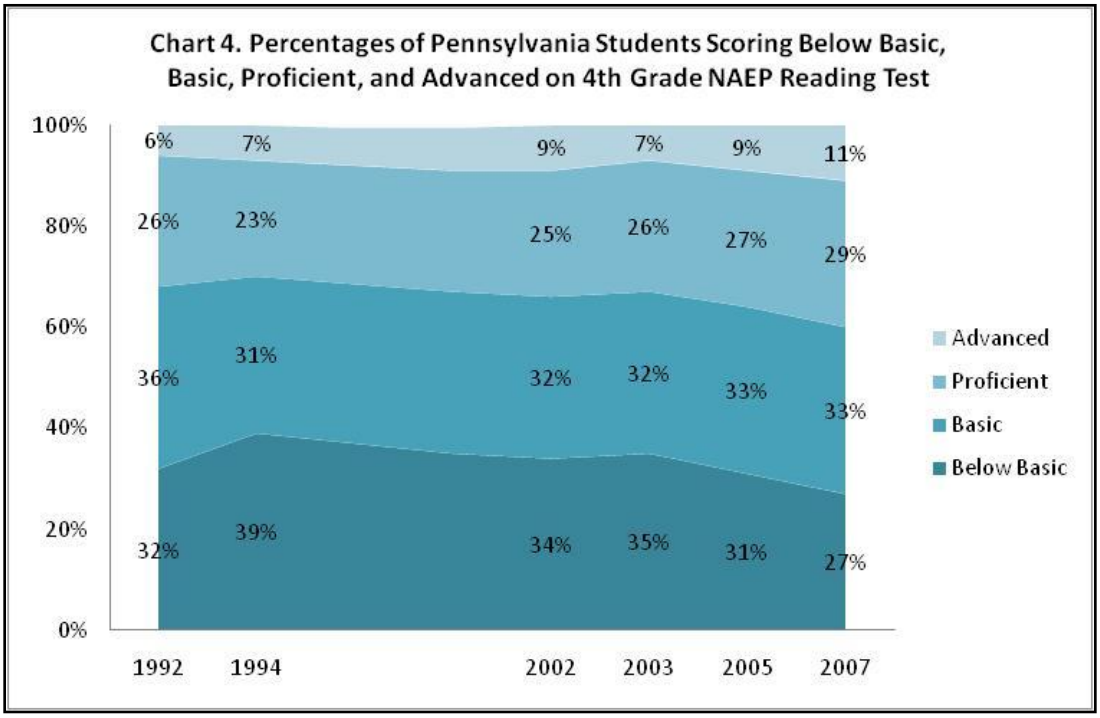
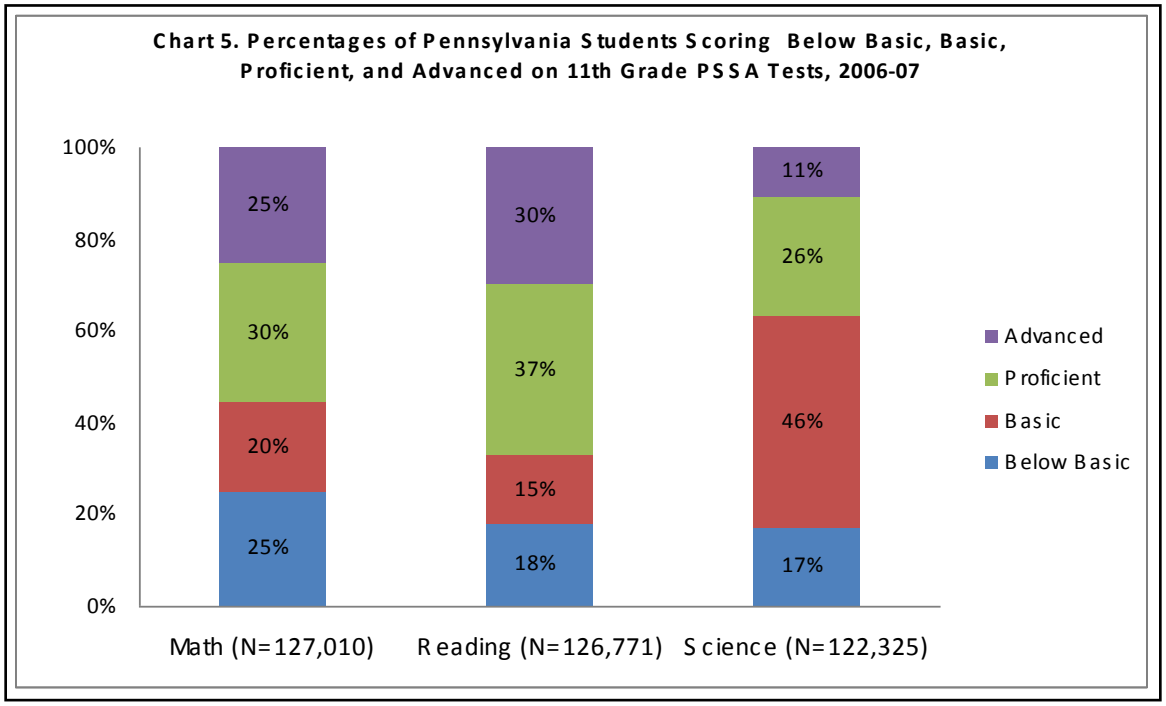


Chart 4. Percentages of Pennsylvania Students Scoring Below Basic, Basic, Proficient, and Advanced on 4th Grade NAEP Reading Test
100%
80%
60%
40%
20%
0%
6%
7%
9%
7%
9%
11%
26%
23%
25%
26%
27%
29%
36%
31%
32%
32%
33%
33%
32%
39%
34%
35%
31%
27%
1992
1994
2002
2003
2005
2007
Advanced
Proficient
Basic
Below Basic



Analytical Results

Most findings about demographic variables observed in the MSPGP sample also persisted in the statewide data analysis as shown by the regression estimates in Table 3. For example, the PSSA performance is positively associated with percentage of white students in the district and percentage of residents with a college degree, while negatively associated with the percentage of low-income households in the community. One interesting finding that is consistent across subjects is that the PSSA performance is negatively associated with district revenue or expenditure.

Stepwise regression analysis using the 2006-07 financial and PSSA data for 498 districts in Pennsylvania reveals that every additional $1,000 spent on a student was associated with a *decrease* by .48 percent in the proportion of 11th grade students scoring proficient or above on the PSSA math test and a decrease of .31 percent in the proportion of 11th grade students scoring proficient or above on the PSSA reading test, after controlling for student racial/ethnic and socioeconomic composition, and education level of local residents (as measured by percentage of community residents holding a bachelor's degree). The direction and magnitude of the regression parameter estimates remain virtually unchanged even when Philadelphia and Pittsburgh school districts, two of the largest and most diverse districts, were excluded from the analysis. This suggests that the observed negative relationship between school funding and student achievement remains relatively consistent across districts in the state.

A similar set of stepwise multiple regression analysis was applied to advanced scoring students. It reveals no relationship between expenditure per student and percentage of students scoring advanced on the PSSA math test and a slightly negative relationship between expenditures and percentage of students scoring advanced on the PSSA in reading. Stepwise regression results show that every additional $1,000 spent on a student was

associated with a decrease by .38 percent in the proportion of 11th grade students scoring advanced on the PSSA reading test.

We also analyzed the percentage of students scoring below basic in 498 districts in Pennsylvania and found a weak positive correlation between per student expenditure and percentage of 11th grade students scoring below basic on PSSA reading (r=.09, p <.05). The regression analysis shows that an additional $1,000 per student expenditure is associated with an increase by .32 percent in proportion of students scoring below basic on PSSA reading, after controlling for student racial/ethnic and socioeconomic composition in the district and the educational level of local residents. On the other hand, an additional $1,000 revenue per student received by a district is associated with an increase by .54 percent in proportion of students scoring below basic on PSSA math. Although these regression estimates for financial determinants are statistically significant, the magnitude of the effects is minute, as further illustrated by the scatterplots in Charts 6 through 9.

Table 3. Regression Estimates for Predictor Variables in Stepwise Regression Analysis of PSSA Math and Reading Performance (N= 498).

Predictor	Outcome					
	% Students Scoring Advanced		% of Students Scoring Proficient or Above		% of Students Scoring Below Basic	
	Math	Reading	Math	Reading	Math	Reading
% of economically disadvantaged students	-.08(.03)***	-.10(.03)**	-.18(.05)***	-.16(.04)***	.18(.04)***	.11(.03)**
% of white students	.14(.02)***	.18(.02)***	.26(.03)***	.29(.03)***	-.27(.03)***	-.25(.02)***
% of residents with college degrees	.58(.04)***	.54(.04)***	.54(.05)***	.42(.05)***	-.35(.05)***	-.27(.03)***
Expenditure per student (in $1,000)	-.0038 (.0013)**		-.0048 (.0018)**			.0032 (.0012)**
Revenue per student (in $1,000)		-.0054 (.0020)**		-.0047 (.0022)*	.0054 (.0022)*	
R^2	.59	.58	.55	.57	.56	.54
F statistic	176.47***	168.34***	151.70***	162.61***	154.27***	146.12***
N	498	498	498	498	498	498

Note. The values within the parentheses are the standard errors. All predictor variables have a tolerance of above .30.
* p< .05, ** p<.01, *** p< .0001.

The following stepwise regression equations were used for the analyses:

DV= %Advanced in Math

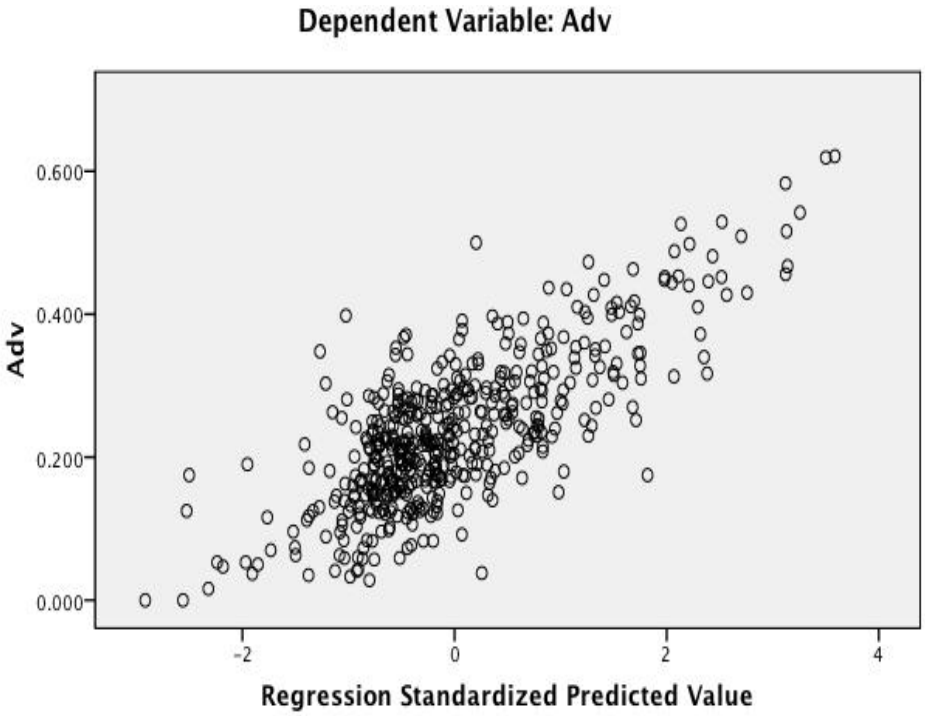
Regression Equation:

%Advanced in Math = .055-.083*%LowSES +.139*%White Students +.577*%College Degrees -.0038Expenditure(in$1000)+$\varepsilon$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.055	.037		1.495	.135
	Low_SES_Econ_Dis	-.083	.033	-.123	-2.506	.013
	WHITE_PER	.139	.024	.224	5.736	.000
	Bachelor	.577	.040	.688	14.472	.000
	Expend	-3.804E-6	.000	-.094	-2.849	.005

a. Dependent Variable: % Adv in Math



DV= %Advanced in Reading

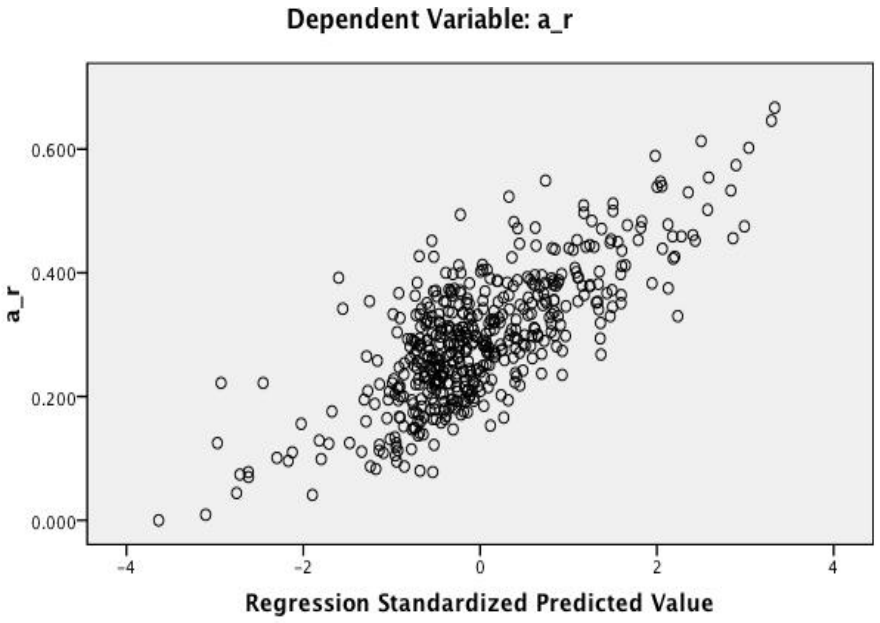
Regression Equation:

%Advanced in Reading = .109-.104*%LowSES +.178*%White Students +.542*%College Degrees -.0054Revenue(in$1000)+$\varepsilon$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.109	.040		2.692	.007
	Low_SES_Econ_Dis	-.104	.035	-.151	-2.982	.003
	WHITE_PER	.178	.025	.283	7.125	.000
	Bachelor	.542	.043	.636	12.482	.000
	Revenue	-5.369E-6	.000	-.097	-2.646	.008

a. Dependent Variable: a_r



DV=% Proficient or Advanced in Math

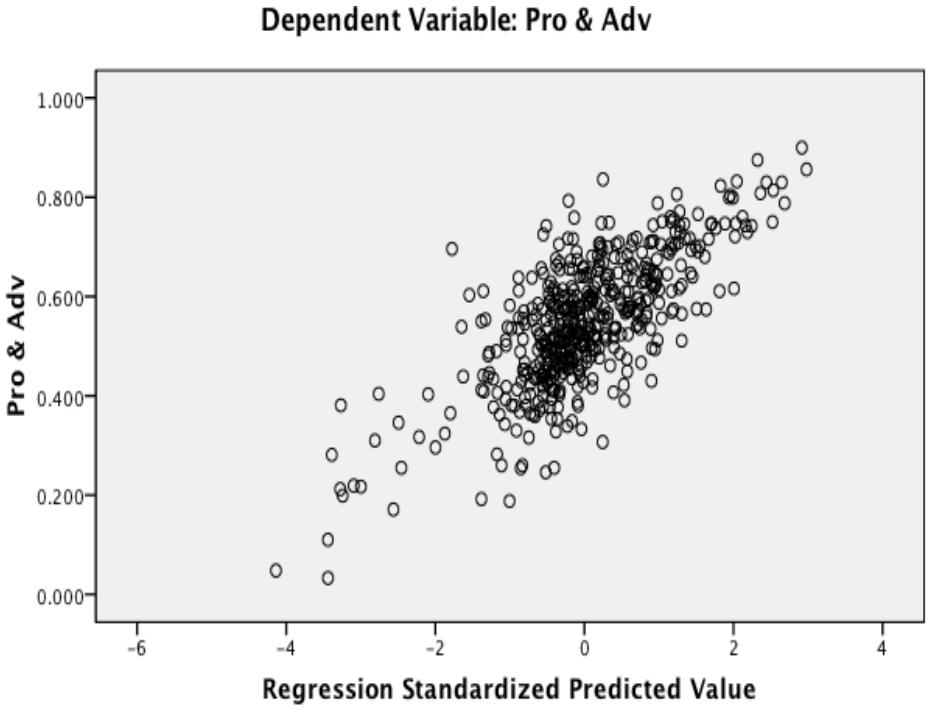
Regression Equation:

%Proficient in Math = .301-.183*%LowSES +.263*%White Students +.543*%College Degrees -.0048Expenditure(in$1000)+$\varepsilon$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.301	.048		6.244	.000
	Low_SES_Econ_Dis	-.183	.044	-.213	-4.156	.000
	WHITE_PER	.263	.032	.336	8.224	.000
	Bachelor	.543	.053	.512	10.317	.000
	Expend	-4.774E-6	.000	-.094	-2.708	.007

a. Dependent Variable: Pro & Adv



DV= % Proficient or Advanced in Reading

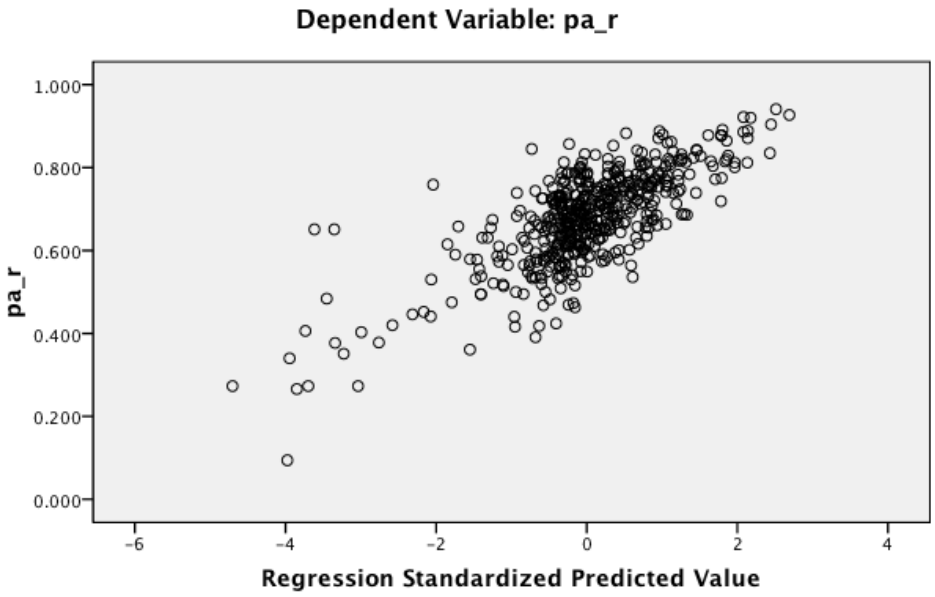
Regression Equation:

%Proficient in Reading = .433-.159*%LowSES +.285*%White Students +.420*%College Degrees -.0047Revenue(in$1000)+$\varepsilon$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.433	.044		9.838	.000
	Low_SES_Econ_Dis	-.159	.038	-.214	-4.200	.000
	WHITE_PER	.285	.027	.422	10.503	.000
	Bachelor	.420	.047	.458	8.898	.000
	Revenue	-4.744E-6	.000	-.080	-2.152	.032

a. Dependent Variable: pa_r



DV= %Below Basic in Math

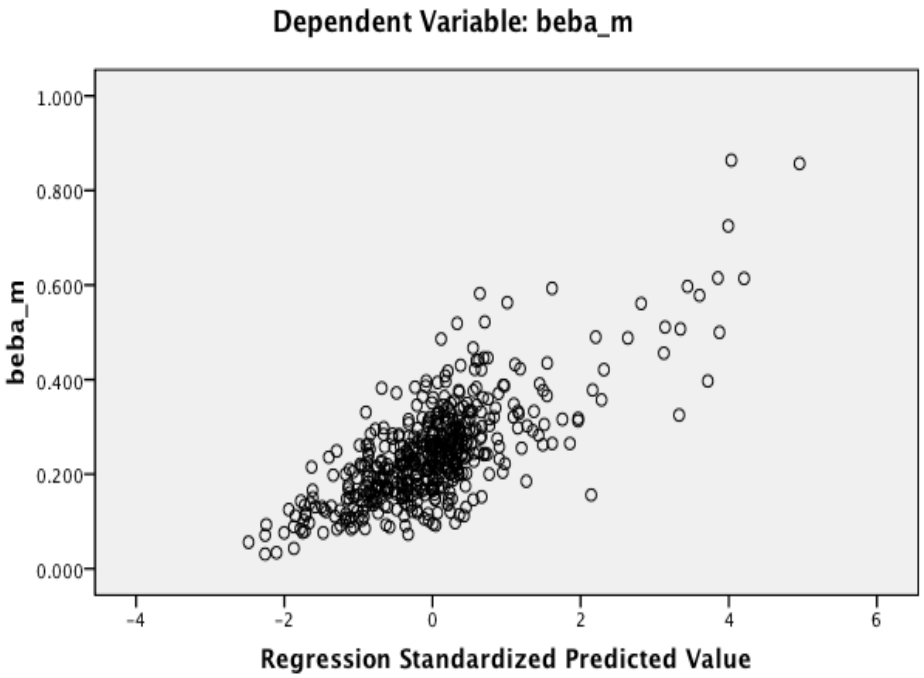
Regression Equation:

%Below Basic in Math = .446 +.181*%LowSES -.268*%White Students -.348*%College Degrees +.0054Revenue(in$1000)+$\varepsilon$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.446	.043		10.392	.000
	Low_SES_Econ_Dis	.181	.037	.255	4.916	.000
	WHITE_PER	-.268	.026	-.412	-10.101	.000
	Bachelor	-.348	.046	-.395	-7.564	.000
	Revenue	5.346E-6	.000	.094	2.486	.013

a. Dependent Variable: beba_m



DV= %Below Basic in Reading

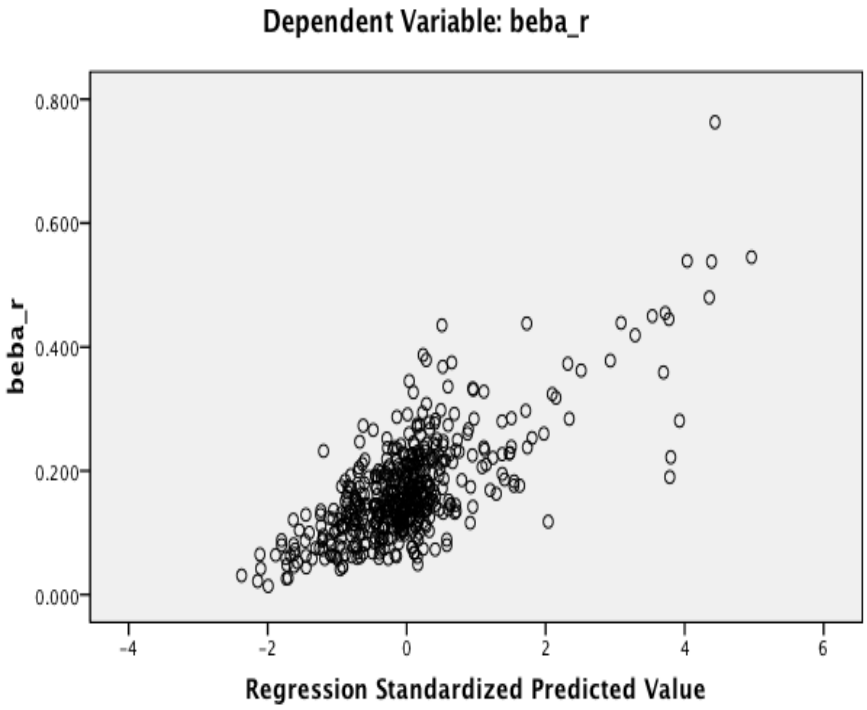
Regression Equation:

%Below Basic in Reading = .384 +.105*%LowSES -.251*%White Students -.265*%College Degrees +.0032Expenditure(in$1000)+$\varepsilon$

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.384	.032		12.080	.000
	Low_SES_Econ_Dis	.105	.029	.188	3.638	.000
	WHITE_PER	-.251	.021	-.491	-11.905	.000
	Bachelor	-.265	.035	-.383	-7.651	.000
	Expend	3.161E-6	.000	.095	2.720	.007

a. Dependent Variable: beba_r



Limitations

This study has several limitations. First of all, our sample consists of only district-level aggregated data in high schools and does not account for district size and intra-district variation in resource allocation and effectiveness. It may be worthwhile to conduct a more rigorous study with school and student-level data in order to understand how funding is allocated within districts and schools and how it works differently for different schools and student cohorts. Secondly, because of the data limitations, there is a possibility that the lack of significant impact is the result of oversimplification of school and non-school resource measurement. Many resources in schools are complex and work together in ways that cannot be purchased with additional money. Our finding about the significant impact of the educational background of community residents on student outcomes suggests that non-school resources are also associated with student performance. These effects may include family members' roles as providers, educators, and role models, and the expectations they hold for the younger generation. Future research is necessary to disentangle these multiple dimensions of contextual factors in order to understand how exogenous variables (such as revenues, state and district policies related to accountability and high stakes exams) affect student outcomes.

Appendix: List of MSPGP Partner Districts

Camden County NJ School Districts
- Berlin
- Camden County Vocational
- Cherry Hill Township
- Collingswood Borough
- East Camden County Regional
- Gloucester Co. Institute of Technology
- Gloucester City
- Haddon Heights
- Haddon Township
- Lindenwold Borough
- Pennsauken
- Riverton Borough
- Winslow

Bucks County PA School Districts
- Bensalem Township
- Bristol Township
- Centennial
- New Hope-Solebury
- Palisades
- Pennridge
- Quakertown Community

Delaware County PA School Districts
- Haverford Township
- Interboro
- Radnor Township
- Ridley
- Rose Tree Media
- Southeast DelCo
- Wallingford-Swarthmore
- William Penn

Lancaster/Chester County PA School Districts
- Lancaster City
- Octorara

Lehigh Valley PA School Districts
- Allentown City
- Bangor Area
- Bethlehem Area
- Easton Area
- Nazareth Area
- Northampton Area
- Saucon Valley

Montgomery County PA School Districts
- Cheltenham Township
- Colonial
- Hatboro-Horsham
- Norristown Area
- North Penn
- Springfield Township

Other NJ and PA School Districts
- MAST Charter
- Northern Burlington County Regional
- Phillipsburg

References

Coate, D. & VanderHoff, J. (1999). Public school spending and student achievement: The case of New Jersey. *Cato Journal, 19*(1), 85-99.

Glenn, W. J. (2009). School finance adequacy litigation and student achievement: A longitudinal analysis. *Journal of Education Finance, 34*(3), 247-266.

Gronn, P. (2002). "Distributed leadership." In K. Leithwood & P. Hallinger (Eds.) *Second International Handbook on Educational Leadership and Administration.* Dordrecht, The Netherlands: Kluwer Publishers, 653-696.

Grubb, W. N. (2008). Multiple resources, multiple outcomes: Testing the "improved" school finance with NELS88. *American Educational Research Journal, 45*(1), 104-144.

Hallinger, P. (2000). A review of two decades of research on the principalship using the "Principal Instructional Management Rating Scale." Paper presented at the annual meeting of the American Educational Research Association, Seattle, Washington.

Kim, J. S., & Sunderman, G. L. (2005). Measuring academic proficiency under the No Child Left Behind Act: Implications for Educational Equity. *Educational Researcher, 34*(8), 3-13.

Lee, V.E. & Burkham, D.T. (2002). Inequality at the starting gate. Washington, D.C.: Economic Policy Institute.

Leithwood, K. & Jantzi, D. (2000). The effects of transformation leadership on student engagement with school. *Journal of Educational Administration, 38*, 2, 112-129.

Peevely, G. L., & Ray, J. R. (2001). Does equalization litigation effect a narrowing of the gap of value added achievement outcomes among school districts? *Journal of Education Finance*, *26*, 319-332.

Pennsylvania Department of Education (2009). State Academic Standards. Retrieved May 25, 2009 from http://www.pde.state.pa.us/stateboard_ed/cwp/view.asp ?a=3&Q=76716&stateboard_edNav=|5467|&pde_internetNav=|&a_and_tNav=|

Rebell, Michael A. (2006). Professional rigor, public engagement and judicial review: A proposal for enhancing the validity of education adequacy studies. *Teachers College Record, 109*, 6.

Ritter, G. W., & Lauver, S. C. (2003). School finance reform in New Jersey: A piecemeal approach to a systematic problem. *Journal of Education Finance, 28*, 575-598.

U.S. Department of Education (2007). *The nation's report card: State snapshot report 2007*. Retrieved May 25, 2009 from http://nces.ed.gov/nationsreportcard/pdf/ stt2007/2007495PA8.pdf.

Yeh, Stuart S. (2007). The cost-effectiveness of five policies for improving student achievement. *American Journal of Evaluation, 28*, 4, 416-436.