

Are Educational Expenditures Associated with 11th Grade Student Achievement in Pennsylvania School Districts?

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The 21st Century Partnership for STEM Education
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This study was done with funding from the National Science Foundation. Award Number: 0314806. The findings and conclusions are the responsibility of the authors and do not necessarily reflect the views of the NSF.

Acknowledgements: The analysis was carried out by a team of statisticians and data analysts who included:

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- *Jill Feldman*, Ph.D., Director of Evaluation, Research for Better Schools
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1. Summary of Findings

In 2009, Pennsylvania public schools spent nearly \$23.5 billion to educate approximately 1.8 million publicly enrolled K-12 students of whom about 600,000 were enrolled in high school. The purpose of this report is to examine whether and to what degree Pennsylvania school district expenditures per pupil are related to high school student achievement as measured by 11th grade PSSA proficiency rates and SAT scores across 498¹ districts. A second purpose is to study whether and to what extent other factors are associated with 11th grade student achievement separate and apart from educational expenditures.

This report examines four years: 2007, 2008, 2009 and 2010. We looked at the association of 15 categories of school expenditures per pupil to 11th grade student achievement as it occurred in 2007, 2008, and 2009. The 11th grade student achievement measures that are available are: PSSA scores in math, reading and science and SAT math and verbal scores. [For 2010 we had only the PSSA scores as the 2010 financial data was not available at the time of this report.]

This report analyzes whether any categories of school spending were related to 11th grade student achievement. We also looked at the effect of *changes* in expenditures between 2007 and 2009 and their corresponding changes in achievement. We conducted this analysis in a way that would be most favorable to the claim that higher district expenditures would result in higher achievement levels.

By “association” we mean more than whether the relationship between an input and outcome variable reached “statistical significance,” that is, whether a relationship exists by chance alone, but more importantly, to what degree the relationships are *practically* significant. In other words, it is important to know of how increasing the magnitude of one input variable is associated with changes in the magnitude of another.

In sum, we found there was either no or very weak association between levels of education expenditures and 11th grade student achievement after controlling for other variables.

Instead, the strongest association with high school student achievement for both PSSA scores and SAT scores is the percentage of adults in a district who have earned a four year college degree (bachelors). This is followed by the percentage of White students in a district and the percentage of students eligible for free and reduced lunch. Spending per pupil, regardless of expenditure category, had either no association with student achievement or at best only a weak positive or a weak negative correlation with student achievement.

¹ Of the 501 total school districts in Pennsylvania, only 498 have high schools.

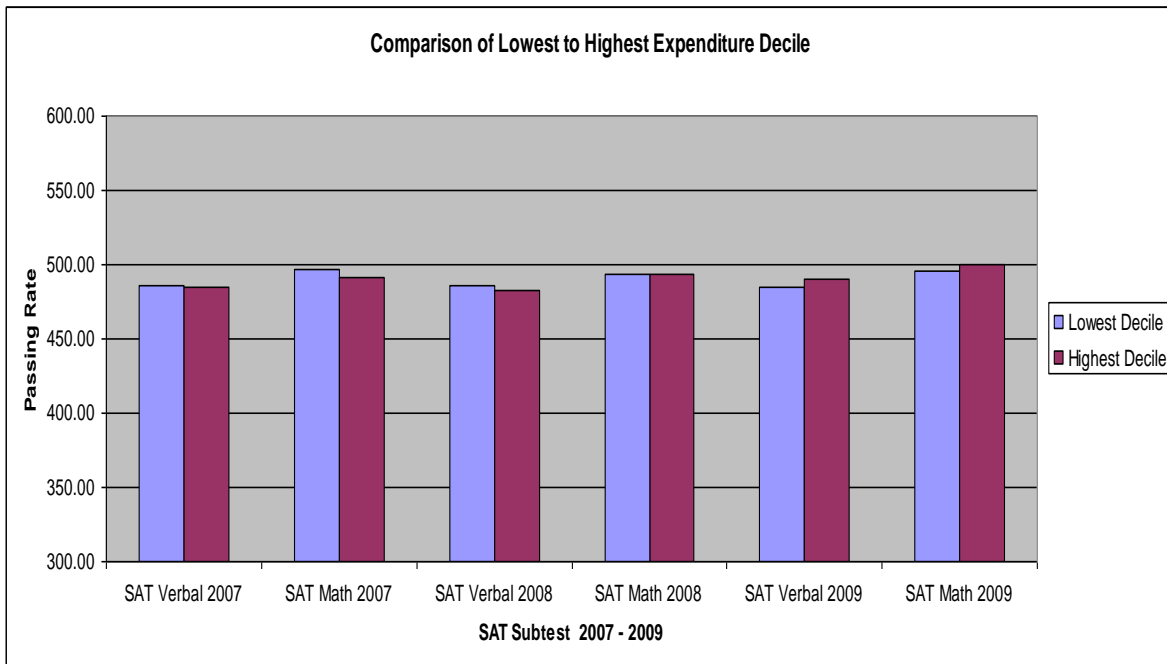
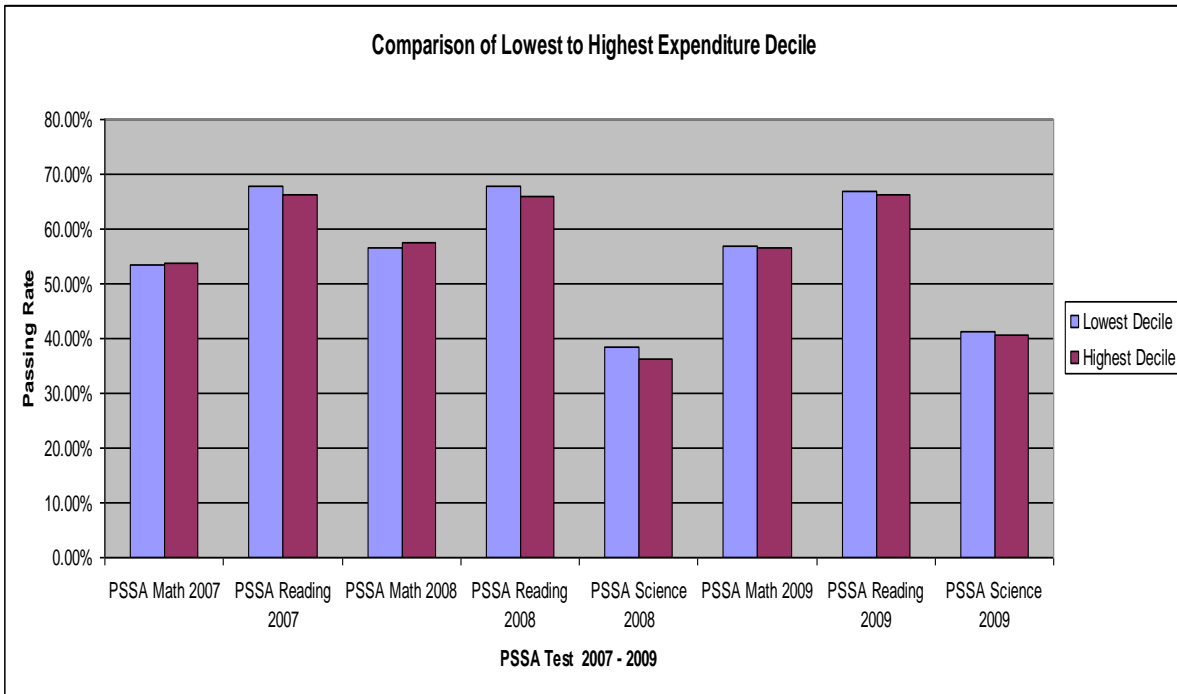
By any measure, high school achievement in Pennsylvania is not stellar. Less than 80% of 9th graders complete a high school degree in 4 years and of those who do only 57% are proficient or advanced in math. Over the past 8 years, the rates of students scoring proficient or advanced in 11th grade math has improved only about 1% point per year from 49% to 57% while reading has increased only about 5 percentage points. .

Given that Pennsylvania's economy is the 17th largest in the world at over \$550 billion, with a civilian labor force of 6.4 million workers, it is critical to Pennsylvania's future prosperity that students learn the skills and subject matter that will enable the Commonwealth to compete in a 21st century global economy that has witnessed explosive growth in science and technology. Other industrialized countries have overtaken the United States in the percentage of its young people with 2 and 4 year college degrees. There is an urgency to better prepare young people for college and career success. Moreover, the gaps in achievement between Asian and White students, and White and African American and Hispanic students persist in size and scope.

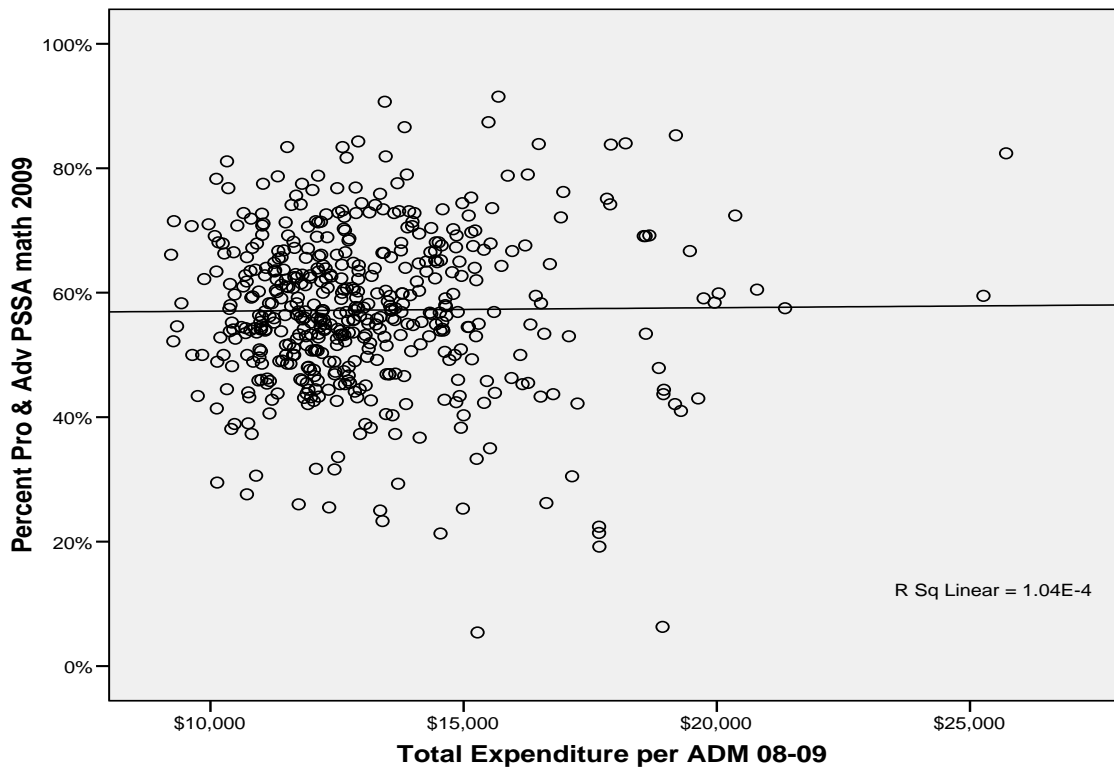
The gap in per pupil expenditures in 2009 ranged between \$8,174 and \$23,009. It is understandable that many would feel there is the urgent necessity, if not moral imperative, to try to solve the problems of low 11th grade student performance by spending more money to narrow these gaps in expenditures. Yet, the results of our study show that district Total Expenditures per pupil are not, in fact, associated with 11th grade PSSA proficiency in math, reading or science, or SAT math and verbal scores in 2007, 2008, 2009 to any practical degree. The correlations between these variables are near zero and in some cases even slightly negative. Moreover, we found that the relationship between *changes* in expenditures from 2007-2009 and changes in student outcomes are weak at best.

In our previous report, we noted that other studies also have not found a strong link between student achievement and public educational expenditures in Pennsylvania, (Merlino et al., 2009). Studies on the effects of "adequacy litigation," (lawsuits to address inequities in school funding), on subsequent student achievement have found limited results. For example, 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 court decision which ordered 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. 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. Glenn (2009) study found only a small effect size between adequacy litigation and very low SES Pre K-5 students. Grubb (2008) has argued that "simple resources," or single factor investments, such as money alone, are likely to be a necessary but not sufficient condition for improved teaching and learning outcomes.

To illustrate the absence of relationship between 11th grade student achievement and expenditures per pupil in Pennsylvania we show three graphics below. The first two graphics depict the relationship between per pupil expenditures and 11th grade student achievement on PSSA and SAT tests. For these graphs we selected the top 50 districts with the highest per pupil expenditures (“highest decile”) and compared them to the bottom 50 districts with the lowest per pupil expenditures (“lowest decile”) from 2007 to 2009. As one can see, there are no discernable differences in student achievement outcomes.



Another way to see the weakness in a relationship between education expenditures and student achievement is to plot each district's 11th grade achievement against its per pupil expenditures. An example is presented below for 11th grade math PSSA and educational expenditures in the 2008-09 academic year. The flat line indicates there is no relationship. Looking across the scatterplot, as expenditures increase from just below \$10,000 to just over \$25,000, we see the rates of district student proficiency equally distributed above and below the 57% average. In other words, for a total per pupil expenditures of \$15,000, there are just as many districts scoring proficient as there are at \$12,000 per pupil or at \$20,000 per pupil, and just as many district not scoring Proficient or Advanced.



We caution the reader to keep two limitations of this study in mind. First, we had to limit our student achievement measures to what are publically available at present, namely PSSA math, reading and science scores, and SAT math and verbal scores. A legitimate question to ask is whether 11th grade PSSA and SAT tests truly measure “student achievement” and the total contributions of high schools to a student’s development? Perhaps other student outcome measures would produce a positive correlation with aggregate educational expenditures.

Given the size of Pennsylvania’s economy one potentially important outcome variable that is not collected is student performance on internationally benchmarked tests. Other outcome measures could be collected and/or reported by the Pennsylvania Department of Education (PDE) but are not available presently. Several new student outcome measures are in the set-up phase for

collection. These measures include: 1) student course enrollment, course completion and grade data; 2) the rate at which a cohort of 9th grade students graduate from high school within four years; 3) the percent of high school graduates who enter college and their enrollment status after 1 and 2 years; 4) student achievement in academic subjects other than math and reading; and 5) 9th and 10th grade Keystone exams.

Some have argued that there is not much hope in finding anything materially different from our results in this study (Rebell, 2006), but it is worth the effort to take a fresh look. For example, in a previous analysis of math and science course completion data in 48 high schools from Pennsylvania and New Jersey², we found a moderate to strong association between levels of college preparatory courses taken by 11th grade and student PSSA and HSPA scores. In an in-depth study of a diverse small urban PA district, we found that students who took three college prep math courses and who achieved a grade of “B or better” in each course were 85% proficient or advanced on the 11th grade PSSA math. In contrast, students who had a “C” in any one of the three courses were only 45% proficient or advanced. PSSA proficiency rates dropped to 15% for students who had a “D” in any one course. Such student course information could be collected by the Pennsylvania’s Information Management System (PIMS) but is not yet available.

A second limitation of this study is the absence of data on internal school organizational variables that previous research has suggested affect student achievement. These internal variables include 1) administrative and teacher staff stability; and 2) curricular and school operational “coherence” (Elmore, 2004). In our previous quantitative research involving 30 Pennsylvania districts, we found that district planning documents are often internally contradictory, without data controls and usually ignored once submitted to Pennsylvania’s Department of Education. The result is often misaligned and poorly implemented school improvement efforts. Such district and school management data pertaining to school planning and program implementation could be collected but is not.

Lastly, it is important to note what we are *not* saying. We are *not* saying that doing business-as-usual will spontaneously improve student outcomes. We are *not* saying that money does not matter. Indeed, relatively modest investments on specific, coherent and well-implemented programs and interventions may yield substantial gains. We *are* saying that to measure the cost-effectiveness of school improvement efforts, a much more robust data collection and research-to-practice infrastructure needs to be established and made available to researchers than what is currently in place in Pennsylvania. A robust data collection and research infrastructure would allow policymakers, practitioners, and researchers to identify and quantify what kinds of interventions and investments in Pennsylvania that be expected to substantively improve high school student outcomes under what conditions.

² Our research described in this section comes from unpublished, preliminary studies conducted with support from the Math Science Partnership of Greater Philadelphia grant.

2. Overview of Data Analysis

The following analyses include 22 high school student achievement variables over three years: 2007, 2008, and 2009. The achievement variables include: 11th grade percentages of proficient/advanced, advanced, and below basic on PSSA math, reading, and science, and school district averages on SAT Math and Verbal.

We chose five primary “input” variables over these same three years. We used two school expenditure variables most used in the research literature: “total spending” and “instructional spending” per student. (Hanushek, 1989; Hedges, 1994). We then added three contextual variables: the percentage of adults in the district who received a bachelor degree; the percentage of students that are White; and the percentage of students who qualify for free or reduced lunch.

The general flow of the following analysis is as follows. We begin by presenting the descriptive statistics of all of the variables. We then show the relationships between expenditures and contextual factors using Pearson correlations. We initially focused on total expenditures since overall these are more positively related to achievement. We wanted to give this financial factor the best chance of significantly contributing to prediction models. Later on in the analysis, we disaggregate the school district expenditures to reveal how different aspects of school spending may relate (or do not relate) to achievement. Here, we added 14 additional subcategories of school spending as our final set of variables in the analysis. Next, we present regression models where we looked at how predictive expenditures were after controlling for the school and community variables. A final set of analyses include a look at changes in scores over the last three years and against changes in expenditures.

3. Descriptive Statistics of Input and Output Variables

We used publically available input variables. The state averages of these variables appear in **Table 1** below. The first column lists the particular outcome variables. “ADM” refers to Average Daily Membership of student enrolled, another name for average attendance. “SD” is the standard deviation. It is a way to measure variability and describes how the data are distributed over a normal curve. Two standard deviations in both directions will describe about 95% of the school districts. The last two columns give the lowest and highest values for each variable. Note the wide differences between high and low values in Total Expenditures per Pupil and Instructional Expenditures per Pupil. In the table, we can also see a rise in expenditures from 2007 to 2009.

Table 1: Descriptive Statistics of Input Variables for 498 School Districts

	Mean	SD	Low	High
Total Expenditure per ADM 2006-07	\$11,931	\$2,058	\$8,174	\$23,009
Total Expenditure per ADM 2007-08	\$12,732	\$2,400	\$8,586	\$26,781
Total Expenditure per ADM 2008-09	\$13,082	\$2,293	\$9,224	\$25,714
Instructional exp per ADM 2006-07	\$6,746	\$1,069	\$4,774	\$11,931
Instructional exp per ADM 2007-08	\$7,118	\$1,185	\$5,093	\$12,718
Instructional exp per ADM 2008-09	\$7,360	\$1,224	\$5,243	\$12,984
Percent of White students	89.33%	16.97%	0.00%	100.00%
Percent of student that are eligible for free/reduced lunch	26.53%	15.49%	0.98%	94.08%
Percent with 4 yr college degree in community	21.54%	12.51%	6.20%	71.70%

Table 2 below describes publically available student outcome variables for years 2007, 2008 and 2009 across all 498 school districts. In our analysis, we included the “percent advanced and proficient” and “percent advanced.” The percentage of student who are proficient or advanced are important because these scores are used to determine whether schools achieve “Adequate Yearly Progress(AYP) under the federally mandated No Child Left Behind Act of 2001.

Table 2: Descriptive Statistics of Student Outcome Variables

	N	Mean	SD	Minimum	Maximum
Percent Adv on PSSA math 2007	498	23.58%	10.50%	0.00%	62.10%
Percent Adv on PSSA math 2008	498	25.52%	11.25%	0.00%	66.10%
Percent Adv on PSSA math 2009	498	25.28%	10.70%	0.00%	68.60%
Percent Pro & Adv on PSSA math 2007	498	54.77%	13.28%	3.30%	90.00%
Percent Pro & Adv on PSSA math 2008	498	57.37%	13.22%	3.30%	90.20%
Percent Pro & Adv on PSSA math 2009	498	57.20%	12.59%	5.40%	91.50%

	N	Mean	SD	Minimum	Maximum
Percent Adv on PSSA reading 2007	498	29.31%	10.67%	0.00%	66.70%
Percent Adv on PSSA reading 2008	498	32.57%	11.36%	1.70%	74.20%
Percent Adv on PSSA reading 2009	498	32.97%	11.74%	0.00%	75.60%
Percent Pro & Adv on PSSA reading 2007	498	67.94%	11.48%	9.40%	94.10%
Percent Pro & Adv on PSSA reading 2008	498	67.26%	11.86%	10.60%	94.20%
Percent Pro & Adv on PSSA reading 2009	498	66.92%	11.74%	18.20%	95.00%
Percent Adv on PSSA science 2008	498	10.23%	6.30%	0.00%	40.70%
Percent Adv on PSSA science 2009	498	16.94%	8.45%	0.00%	51.60%
Percent Pro & Adv on PSSA science 2008	498	37.05%	12.97%	0.80%	77.20%
Percent Pro & Adv on PSSA science 2009	498	40.75%	13.32%	2.50%	78.30%
Average 2007 SAT Math	496	494	33.6	331	598
Average 2008 SAT Math	497	496	34.6	354	594
Average 2009 SAT Math	494	497	34.6	336	609
Average 2007 SAT Verbal	496	486	30.5	360	579
Average 2008 SAT Verbal	497	487	31.2	320	580
Average 2009 SAT Verbal	494	486	31.4	347	587

Note the wide range in values for each outcome measure as seen in the last two columns. For example, some districts have zero percent of students scoring advanced in 11th grade Math PSSA whereas other districts have over 68% scoring advanced. As previously mentioned, average proficiency on all of the outcome measures has remained fairly constant over the past three years in math reading and science.

4. Correlations Between Input and Student Outcome Variables:

We used Pearson Product-Moment Correlation Coefficients to initially identify linear relationships between the five input and 22 student outcome variables. Correlation coefficients go between -1.00 and +1.00, and indicate both the magnitude and direction of a relationship. A positive sign means that an increase in one variable corresponds with an increase in the other variable and a negative sign means that an increase in one variable corresponds with a decrease in the other variable. A coefficient of 0.00 indicates no relationship. A correlation of 1.00 indicates a perfect 1 to 1 correspondence. We define a “weak” correlation from 0.10 to 0.30; a “moderate” from 0.30 to 0.50, and a “strong” from 0.50 to 1.00. We regard correlation coefficients with a value below + - 0.10 to be no different than 0.00. Correlations do not mean one variable caused another, only that the two variables are associated.

Table 3: Input-Outcome Correlations

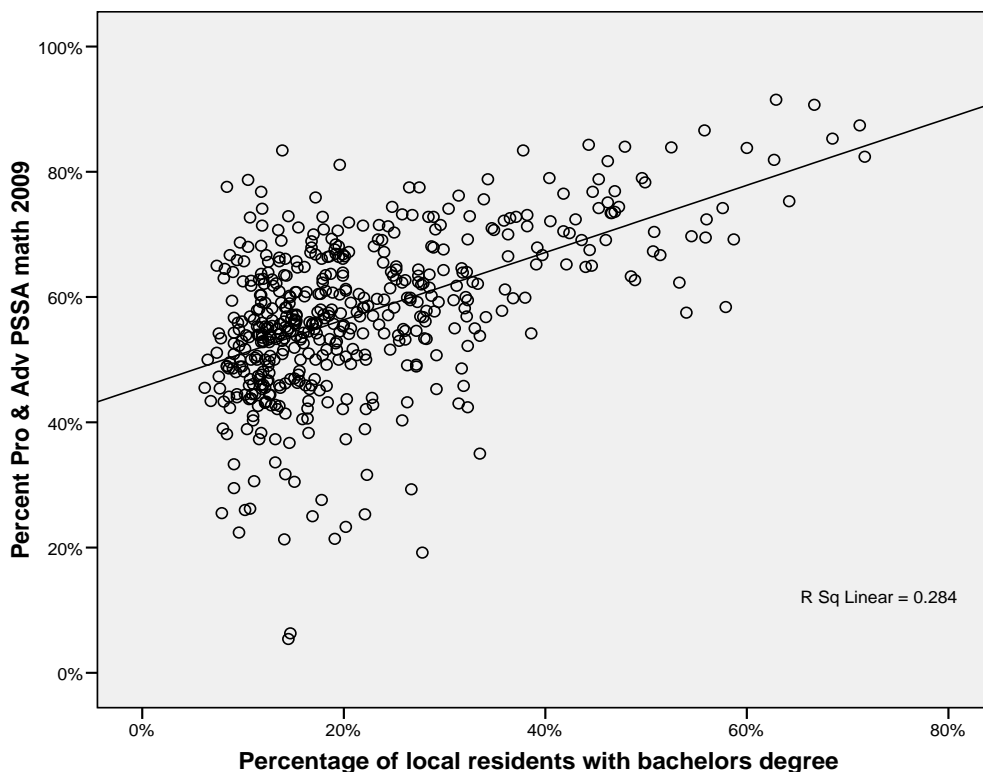
	% with bachelors in the community	% of students that are White	% eligible for free or reduced lunch	Total Expenditure per ADM	Instructional Expenditure per ADM
Percent Adv & Prof PSSA Math 2007	0.554(**)	0.379(**)	-0.666(**)	0.033	-0.071
Percent Adv & Prof PSSA Math 2008	0.536(**)	0.393(**)	-0.661(**)	0.028	-0.055
Percent % Adv & Prof PSSA Math 2009	0.533(**)	0.401(**)	-0.645(**)	0.010	-0.107(*)
Percent Adv & Prof PSSA Reading 2007	0.486(**)	0.475(**)	-0.672(**)	0.002	-0.107(*)
Percent Adv & Prof PSSA Reading 2008	0.504(**)	0.498(**)	-0.695(**)	-0.002	-0.101(*)
% Adv & Prof PSSA Reading 2009	0.544(**)	0.458(**)	-0.711(**)	-0.006	-0.138(**)
Percent Adv & Prof PSSA Science 2008	0.546(**)	0.430(**)	-0.679(**)	0.048	-0.088(*)
% Adv & Prof PSSA Science 2009	0.567(**)	0.436(**)	-0.692(**)	0.007	-0.117(**)
Average 2007 SAT Math	0.614(**)	0.448(**)	-0.772(**)	0.048	-0.064
Average 2008 SAT Math	0.624(**)	0.442(**)	-0.761(**)	0.060	-0.074
Average 2009 SAT Math	0.634(**)	0.429(**)	-0.751(**)	0.075	-0.020
Average 2007 SAT Verbal	0.616(**)	0.432(**)	-0.769(**)	0.066	-0.049
Average 2008 SAT Verbal	0.613(**)	0.425(**)	-0.761(**)	0.050	-0.088
Average 2009 SAT Verbal	0.627(**)	0.431(**)	-0.757(**)	0.094(*)	-0.015
Average	0.571	0.434	-0.714	0.037	-0.078

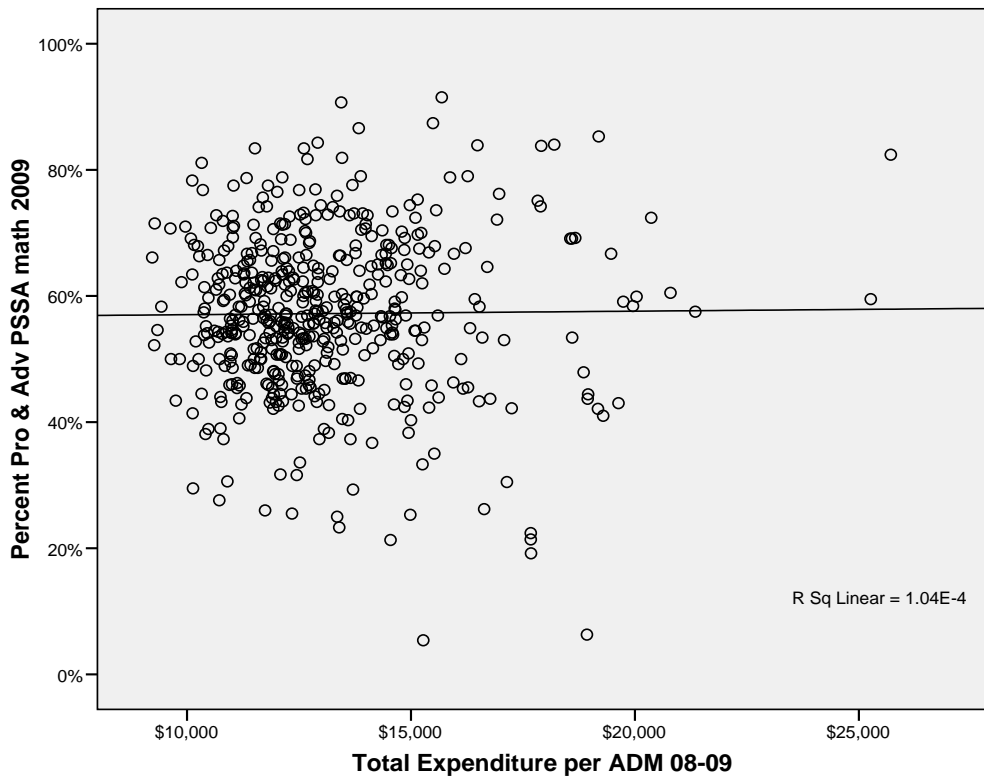
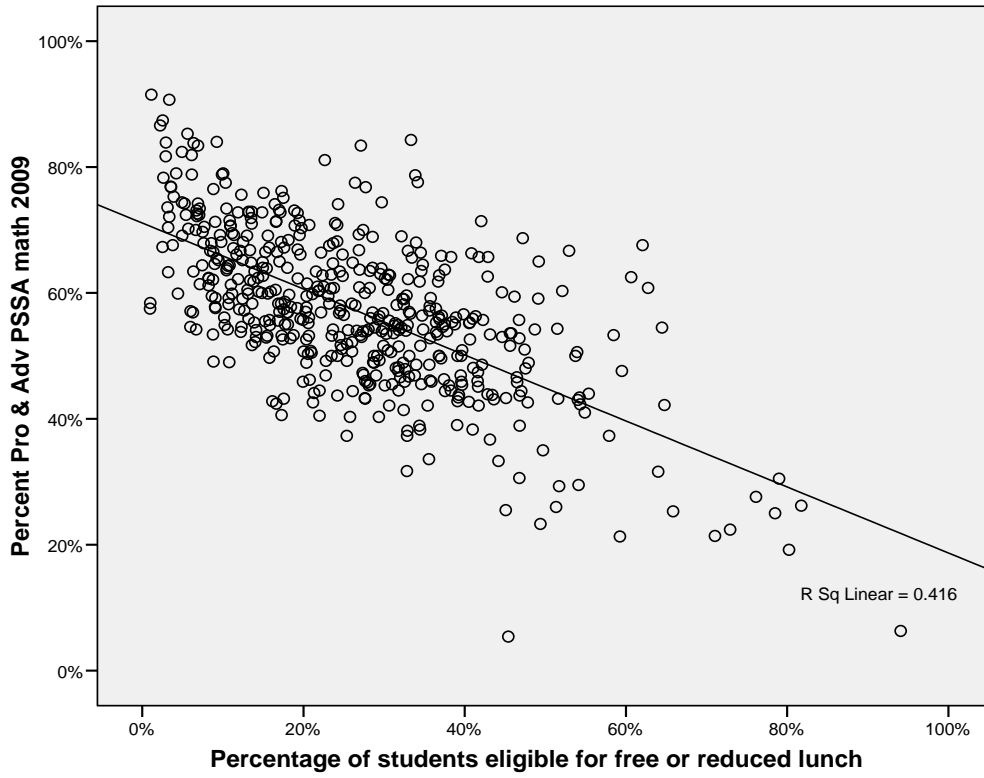
** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

Table 3 above contains five input variables: 1) percentage of students eligible for free or reduced lunch; 2) percentage of White students; 3) percentage of community residents in the district with a 4 year college degree; 4) total expenditure per pupil; and 5) instructional expenditures per pupil. We related each of these input variables to the 14 student outcomes variables. The student outcomes variables are the percent Proficient or Advanced in math, reading and science, and SAT Math and Verbal scores for 2007, 2008 and 2009.

As is apparent, the relationships between the input variables and the student outcome variables are remarkably similar over all three years. The strongest associations to student achievement are in the first three columns. Total and instructional expenditures in the last two columns show either weak or nonexistent relationships to 11th grade student achievement.

As a visual illustration of the relationships presented in Table 3, we show how all 498 school districts fare in three different scatterplots. The first scatterplot shows the strong *positive* association between the percent in the district with a 4 year college degree and PSSA math proficiency. The second scatterplot shows the strong *negative* association between student poverty and PSSA math proficiency. The third scatterplot shows the *absence* of a relationship between Total Expenditures per Pupil and PSSA math proficiency. Similar scatterplots can be depicted for the other years and subjects but the same patterns would be evident.





The Pennsylvania Department of Education has recently released PSSA scores for the 2010 test year. However, the 2010 districts expenditures will not be released the spring of 2011. Nonetheless, the 2010 results are similar to the other years. See Table 3a below.

Table 3a: Continuation of Input-Outcome Correlations

	% with bachelors in the community	% of students that are White	% eligible for free or reduced lunch	Total Expenditure per ADM 2009	Instructional Expenditure per ADM 2009
Percent Adv & Prof PSSA Math 2010	0.466(**)	0.407(**)	-0.600(**)	-0.039	-0.147(**)
Percent Adv & Prof PSSA Reading 2010	0.520(**)	0.493(**)	-0.685(**)	-0.005	-0.147(**)

5. Disaggregating Expenditures: Correlations Between Student Outcomes and 15 Expenditure Categories.

We tested whether there might be certain types of educational expenditures that had stronger associations with 11th grade student outcomes than Total Expenditures or Instructional Expenditures per student. We used 15 subcomponents of Total Expenditures as designated by the Pennsylvania Department of Education. As before, all expenditure measures are divided by ADM so that they are comparable between different sized districts. Analysis was done of 2009 spending only. The disaggregate expenditures are listed below hierarchically with their PDE codes, and descriptions in parenthesis to make certain components clearer as to their meaning:

1. Instruction 1000
 - 1.1. Regular Programs - E/S 1100
 - 1.2. Special and Gifted Education 1200
 - 1.3. Vocational Education Programs 1300
 - 1.4. Other Instructional Programs - E/S 1400 (e.g., summer school and driver’s ed)
2. Support Services 2000
 - 2.1. Pupil Personnel 2100(counseling and attendance)
 - 2.2. Instructional Staff 2200 (teacher support)
 - 2.2.1. School Library Services 2250
 - 2.3. Administration 2300
 - 2.3.1. Office Of The Superintendent (Executive Director) 2360
 - 2.3.2. Office Of The Principal Services 2380
3. Operation of Non-Instructional Services 3000
 - 3.1. Student Activities 3200 (Sports programs and extracurriculars)
 - 3.2. Community Services 3300

In **Table 4** we first look at the descriptive statistics for these 15 subcategories of district expenditures. The mean Total Expenditure per ADM (or per pupil expenditure) was \$13,081 per pupil ranging from \$9,224 to \$25,714. The next largest is Instructional Expenditure. The largest

subcomponent of that was Regular Education spending, averaging \$5,190 per pupil. Support Services make up the next biggest chunk of total expenditure, with an average of \$3,906. Note again the wide range in expenditures across the districts.

Table 4: Descriptive Statistics for 2009 Expenditures Per Pupil for 498 Districts

	Mean	SD	Minimum	Maximum
Total Expenditures	\$13,081	\$2,293	\$9,224	\$25,714
Instructional Exp.	\$7,360	\$1,224	\$5,242	\$12,984
Regular Education Exp.	\$5,190	\$846	\$3,233	\$9,313
Special Education Exp.	\$1,537	\$494	\$593	\$3,706
Vocational Education Exp.	\$404	\$209	\$5.53	\$1,070
Other Education Exp.	\$183	\$191	\$0.50	\$1,641
All Support Services Exp.	\$3,905	\$761	\$2,359	\$7,998
Student Support Exp.	\$358	\$122	\$88	\$1,207
Teacher Support Exp.	\$401	\$207	\$101	\$2,183
School Library Exp.	\$158	\$56	\$0.47	\$412
Administrative Exp.	\$787	\$186	\$378	\$1,822
Superintendent Exp.	\$159	\$87	\$19	\$1,052
Principal Exp.	\$476	\$1000	\$221	\$1,092
Non-instructional Exp.	\$233	\$114	\$4.90	\$985
Sports and Extracurric.	\$209	\$101	\$9.60	\$568
Community Service Exp.	\$27	\$56	\$0.01	\$637
Average Daily Membership	3,587	9,575	192	206,282

Table 5 below shows a summary of the correlations between the various expense categories and 2009 PSSA math and reading scores. We highlight in **bold** the most *positive* and most *negative* correlations.

The following are overall findings as it relates to the 15 subcategories.

- The majority of relationships between spending and achievement are weak or nonexistent.
- The types of spending that have most positive relationships to student achievement pertain to school libraries, student support, instructional support, and sports programs/extracurricular. The relationships are still fairly weak.
- The types of spending that have negative relationships to achievement are vocational education, special education, other education, office of superintendent, and community service. These relationships, though negative, are still weak.
- Spending that has no relationship with achievement are: total expenditures, administration, and non-instructional expenditures.

Table 5: Summary Correlations between Various District Expenditures Per Student and Achievement for 2009

	% Pro/Adv PSSA Math 2009	% Pro/Adv PSSA Reading 2009	% Pro/Adv PSSA Science 2009	Average 2009 SAT Verbal	Average 2009 SAT Math
Total Expenditures.	0.010	-0.006	0.007	0.094(*)	0.075
Instructional Exp.	-0.107(*)	-0.138(**)	-0.117(**)	-0.015	-0.020
Regular Education Exp.	0.062	0.045	0.054	0.161(**)	0.150(**)
Special Education Exp.	-0.147(**)	-0.177(**)	-0.139(**)	-0.069	-0.067
Vocational Education Exp.	-0.208(**)	-0.180(**)	-0.181(**)	-0.189(**)	-0.195(**)
Other Education Exp.	-0.270(**)	-0.312(**)	-0.321(**)	-0.313(**)	-0.307(**)
All Support Services Exp.	0.065	0.054	0.075	0.125(**)	0.106(*)
Student Support Exp.	0.174(**)	0.168(**)	0.174(**)	0.270(**)	0.274(**)
Teacher Support Exp.	0.118(**)	0.095(*)	0.140(**)	0.158(**)	0.156(**)
School Library Exp.	0.240(**)	0.239(**)	0.280(**)	0.346(**)	0.341(**)
Administrative Exp.	-0.010	-0.074	-0.040	-0.058	-0.057
Superintendent Exp.	-0.091(*)	-0.164(**)	-0.104(*)	-0.128(**)	-0.142(**)
Principal Exp.	0.079	0.036	0.040	0.067	0.071
Non-instructional Exp.	0.081	0.042	0.045	0.024	0.009
Sports & Extracurric. Exp.	0.145(**)	0.140(**)	0.125(**)	0.116(*)	0.088
Community Service Exp.	-0.122(*)	-0.203(**)	-0.172(**)	-0.200(**)	-0.189(**)

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

Cost of Living Considerations in Pennsylvania: What about cost-of- living differences across Pennsylvania? Do these differences mask stronger but otherwise hidden relationships between the levels of educational expenditures and student achievement? To account for differences in cost of living, we created “rates” for all 15 sub categories of expenditures. Instead of looking at dollars spent per pupil, we used the *percent* of each category of expenditure to the total amount of expenditure. This rate gives the percentage of money allotted to a certain subcomponent of spending.

Table 6 lists the mean rates across Pennsylvania for each spending category. For example, the mean proportion spent on instruction is the largest, at 56.57%, of the total budget, with regular education being the largest part of that, taking up 39.96% of the Total Expenditures.

Administration accounts for about 6.5% of total expenditures. Libraries account for only 1.2%, on average.

Table 6: Descriptive Statistics Rates of Subcategories of Expenditures to Total Expenses for 498 Districts

	Mean	SD	Minimum	Maximum
Instructional Rate	0.57	0.05	0.29	0.69
Regular Education Rate	0.40	0.04	0.22	0.52
Special Education Rate	0.12	0.03	0.04	0.21
Vocational Education Rate	0.03	0.02	0.00	0.08
Other Education Rate	0.01	0.02	0.00	0.15
All Support Services Rate	0.30	0.03	0.16	0.39
Student Support Rate	0.03	0.01	0.01	0.06
Teacher Support Rate	0.03	0.01	0.01	0.11
School Library Rate	0.01	0.00	0.00	0.02
Administrative Rate	0.06	0.01	0.03	0.12
Superintendent Rate	0.01	0.01	0.00	0.06
Principal Rate	0.04	0.01	0.02	0.07
Non-instructional Rate	0.02	0.01	0.00	0.06
Sports and Extracurric. Rate	0.02	0.01	0.00	0.04
Community Service Rate	0.00	0.00	0.00	0.04

Next we ran correlations between the rates of expenditures for each district against its 11th grade student achievement. See **Table 7** below. Again we see a pattern similar to that of **Table 5**. The rate or percentage spent on School Libraries had the most positive relationship to PSSA proficiency in not only Reading, but Math, Science, and both SAT subtests as well.

Table 7 Summary Correlations between Various District Expenditures Rates and Achievement for 2009

	% Prof/Adv PSSA Math 2009	% Prof/Adv PSSA Reading 2009	% Prof/Adv PSSA Science 2009	Average 2009 SAT Math	Average 2009 SAT Verbal
Instructional Rate	-0.208(**)	-0.227(**)	-0.229(**)	-0.174(**)	-0.197(**)
Regular Education Rate	0.085	0.089(*)	0.070	0.097(*)	0.088(*)
Special Education Rate	-0.218(**)	-0.246(**)	-0.206(**)	-0.162(**)	-0.178(**)
Vocational Education Rate	-0.202(**)	-0.164(**)	-0.170(**)	-0.181(**)	-0.184(**)
Other Education Rate	-0.232(**)	-0.266(**)	-0.286(**)	-0.272(**)	-0.283(**)
All Support Services Rate	0.085	0.100(*)	0.102(*)	0.049	0.055
Student Support Rate	0.190(**)	0.184(**)	0.184(**)	0.258(**)	0.241(**)
Teacher Support Rate	0.119(**)	0.095(*)	0.136(**)	0.133(**)	0.129(**)
School Library Rate	0.232(**)	0.240(**)	0.273(**)	0.296(**)	0.292(**)

	% Prof/Adv PSSA Math 2009	% Prof/Adv PSSA Reading 2009	% Prof/Adv PSSA Science 2009	Average 2009 SAT Math	Average 2009 SAT Verbal
Administrative Rate	-0.021	-0.074	-0.055	-0.132(**)	-0.153(**)
Superintendent Rate	-0.090(*)	-0.153(**)	-0.106(*)	-0.157(**)	-0.156(**)
Principal Rate	0.078	0.046	0.033	0.003	-0.020
Non-instructional Rate	0.071	0.042	0.038	-0.028	-0.016
Sports and Extracurric. Rate	0.125(**)	0.128(**)	0.108(*)	0.037	0.061
Community Service Rate	-0.114(*)	-0.191(**)	-0.166(**)	-0.179(**)	-0.191(**)

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

Other Patterns of Spending: One popular policy initiative is based on the theory that teacher supports (like professional development) should relate to achievement. The way the Pennsylvania Department of Education defines teacher support, however, includes School Library funding. We removed the School Library spending from teacher support category to see what the effect of this more pure factor would be. We found that there is very little, if any, of a relationship between this factor and achievement. See **Table 8**

Table 8: Teacher Instruction Support and Achievement Correlations

	Teacher Instructional Support Expenditure 2009
Percent Adv on math 2009	.093(*)
Percent Pro & Adv on math 2009	.057
Percent Below Basic math 2009	-.024
Percent Adv on reading 2009	.103(*)
Percent Pro & Adv on Reading 2009	.032
Percent Below Basic reading 2009	-.010
Percent Adv on science 2009	.130(**)
Percent Pro & Adv on science 2009	.069
Percent Below Basic science 2009	.024
Average 2009 SAT Math	.070
Average 2009 SAT Verbal	.071

Another theory is that the proportion of Instructional Expenditures spent on non-regular education would adversely affect student proficiency levels. To test this theory we created two ratios: 1) “regular education vs. special education”, and 2) “regular education vs. a non-regular” (a combination of special, vocational, and other education expenditures).

Table 9: Regular Education Ratios and Achievement Correlations

	1) Regular Ed to Special Ed Ratio 2009	2) Regular Ed to Non-regular Ed Ratio 2009
Percent Pro & Adv on math 2009	.173(**)	.312(**)
Percent Adv on math 2009	.078	.271(**)
Percent Below basic math 2009	-.215(**)	-.294(**)
Percent Pro & Adv on reading 2009	.211(**)	.340(**)
Percent Adv on reading 2009	.130(**)	.337(**)
Percent Below basic reading 2009	-.230(**)	-.341(**)
Percent Pro & Adv on science 2009	.148(**)	.304(**)
Percent Adv on science 2009	.090(*)	.278(**)
Percent Below basic science 2009	-.307(**)	-.338(**)
Average 2009 SAT Verbal	.149(**)	.299(**)
Average 2009 SAT Math	.140(**)	.294(**)

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

In **Table 9** above, the ratio of “regular to non-regular education” has a **moderate** relationship with achievement. This means that more *percentage* spent on regular education vs. other instructional areas, the more positive the student outcomes. This may help explain the overall negative correlation between instructional spending and achievement: it is most likely due to non-regular education spending.

In **Table 10** we tested to see if there was a relationship between all spending *outside* of instruction and achievement. We subtracted instructional spending from the total. The correlations are weak if there is a relationship. The weak relationships would be read to mean that the more money spent by the district *outside* of the classroom has a weak but positive relationship with achievement.

Table 10: All Non-Instructional Expenditures and Achievement Correlations

	All Non-instruction Expenditure 2009
Percent Advanced on math 2009	.160(**)
Percent Pro & Adv on math 2009	.103(*)
Percent Below Basic math 2009	-.076
Percent Advanced on reading 2009	.182(**)
Percent Pro & Adv on reading 2009	.103(*)
Percent Below basic reading 2009	-.080
Percent Advanced on science 2009	.153(**)
Percent Pro & Adv on science 2009	.106(*)
Percent Below basic science 2009	-.049
Average 2009 SAT Math	.129(**)
Average 2009 SAT Verbal	.154(**)

6. Multiple Linear Regression Analyses

We next held all other input variables constant to see what effect variations in educational expenditures had on student achievement. “Multiple linear regression” produces a statistic that describes the effect of a single variable (e.g., expenditure) while controlling for all other predictor variables in the model. Simple correlations have already pointed to the minimal relationship between total expenditures and student achievement in Pennsylvania. The regression models allow us to see the effect of spending when controlling for community and school factors. Using multiple linear regression analyses we tested the following education production formula:

$$\text{Percent Eligible for Free or Reduced Lunch} + \text{Percent White} + \text{Percent Bachelors} + \text{Per Pupil Expenditure} = \text{Achievement.}$$

We ran this same model 14 times corresponding to the different achievement variables: PSSA reading, mathematics, and science passing rates and average SAT mathematics and verbal from 2007-2009. Percentages of White students, percentage of students eligible for free or reduced lunch, and percent of community members with four-year degrees remained the same in each model. Per pupil expenditure, however, matched the year the test was given.

In our models we only looked at percent Proficient + Advanced. We used total expenditures per pupil because, according to the correlations, this had a more positive relationship with achievement than instructional spending. Moreover, the research literature tends to use this measure. Our four variable design accounted for between 53.8% of the variability in 2008 Math PSSA passing scores at the low end, and 71.5% of the variability in 2007 SAT Math average at the high end. This is very impressive in social science research, especially with so few predictor variables. The ANOVA tells us that the model is significant.

Results for 2007 PSSA math scores. Table 11 shows the results from one model which serves to illustrate a typical result. For the student outcome variable, we used “2007 Percent Proficient or Advanced in PSSA Math.” Results from other years and more technical details appear in Appendix 7.

Table 11: Regression coefficients from 2007 PSSA passing model

Input Variable	Unstandardized Regression Coefficient (B)	Standardized Regression Coefficient (Beta)
% F/R Lunch Eligible	-0.170	-0.199
% White	0.275	0.351
% Bachelor	0.561	0.528
Per Pupil Expenditures (in \$)	-0.001	-0.103

Looking under the **Unstandardized Regression Coefficient (B)** column here is what the numbers mean.

1. For every 10% increase in the percentage of students eligible for free or reduced lunch in a district, holding other variables constant, you would see a *decrease* in by 1.70 percent.
2. For every 10% increase in the percentage of White students in a district, holding other variables constant, you would see a 2.75 percent point *increase* in the percentage proficient or advanced
3. For every 10 percentage point increase in community members with Bachelors degrees, holding all other variables constant, you would expect to see an *increase* of **5.61** percent points of students scoring proficient or advanced. This factor was the largest contributor in the model.
4. An increase of in per pupil spending by \$1,000, holding other variables constant, is associated with a *decrease* of 1 percentage point Proficient and Advanced on 2009 PSSA math scores. Total expenditures are the smallest contributor in the model, with a very small, negative effect.

In sum, the effect of per pupil expenditure remains extremely small in all of the models, even when it was statistically significant. Often per pupil expenditure was negative in the models.

7. Change in Expenditures vs. Change in Achievement from 2007 to 2009:

In our final set of analyses, we consider whether *changes* in spending from 2007 and 2009 were associated with *changes* in achievement during the same period. While the regression models in the previous section did not show much change in results across the three years, we conducted these analyses to respond to an assumption of the Costing-out Study conducted by APA and presented to the state legislature in November of 2007. The Costing-out Study called for increased spending in the majority of districts in the state to improve achievement. We use the most recently available data, from 2009, to see if there has been an effect on achievement. Note that we have not included PSSA science because that test was not given in 2007, but the other four achievement measures were: PSSA math and reading and SAT verbal and math.

Results: Again, we only see a weak correlation between financial markers and achievement, and here only between instructional expenditures and change in PSSA passing rates. Change in SAT scores is completely unrelated to changes in spending. Change in total expenditures is unrelated to change in achievement across the board.

We did, however, see a change in the direction of the correlations. Previously when we looked at simple correlations between expenditures and achievement, instructional expenditures tended to

be *negatively* related while total expenditures were positive. This time, change in instructional expenditures between 2007-2009 had a weak but *positive* correlation with changes in percent Proficient and Advanced and Percent Advanced and weak negative correlation with percent Below Basic (before it was positive).

In what follows, we look at the effects of changes in expenditures in more detail. We first look at descriptive statistics, then correlating within the achievement and school and community factors, before last looking at the correlations between achievement and district expenditures.

Descriptive statistics, shown in **Table 12**, give us important information. Total expenditures per pupil, on average, rise \$1,151 from 2007 to 2009. Changes in instructional expenditures are smaller, at \$613. The most negative change is \$38 while the largest positive change is \$3,833, with 95% of the districts seeing an increase of somewhere between \$210 and \$1,017.

Table 12: Descriptive Statistics for Changes 2007-2009 in 498 Districts

	Mean	Std. Deviation	Minimum	Maximum
Total Expenditure Change	\$1,151	\$1,361	-\$9,864	\$11,043
Instructional Exp Change	\$613	\$403	-\$38	\$3,833
Change in SAT math	1.73	16.68	-66.00	57.00
Change in SAT verbal	-.24	16.55	-54.00	61.00
Change in % Adv on PSSA math	1.70	7.05	-19.70	26.80
Change in % Pro/Adv on PSSA math	2.43	8.53	-27.70	30.20
Change in %Below Basic PSSA math	-2.04	7.06	-26.40	21.90
Change in % Adv on PSSA reading	-4.04	8.15	-34.10	27.80
Change in % Pro/adv on PSSA reading	-10.73	8.81	-42.70	15.40
Change in % Below Basic PSSA reading	5.56	6.63	-13.50	37.00

Change in passing rates for the PSSA math go up by 2.43 percentage points, while passing rate for PSSA reading go down by 10.73 percentage points. Change in SAT scores is negligible.

Finally, in **Table 13** below, we look at changes in total expenditure from 2007 to 2009 and changes in achievement tests in the same time period. Changes in total expenditures are unrelated to changes in either SAT or PSSA. Changes in instructional expenditures are unrelated to changes in SAT scores, but they do have a weak positive relationship with percent proficient or advanced on PSSA math and reading. However, the positive correlation between PSSA math and Instructional Expenditures, for example, when looked at in a regression model revealed a minimal effect; a change in spending of \$1,000 per pupil from 2007 to 2009 results in a 3

percentage point increase in the percent scoring proficient and advanced on the PSSA 11th grade math assessment (B=.003, see Appendix 7 for the model).

Table 13: Correlations between Change in District Expenditures and Achievement from 2007 to 2009

	Change in Total Expenditures	Change in Instructional Expenditures
Change in PSSA Math Passing Rate	0.052	0.132(**)
Change in PSSA Reading Passing Rate	0.025	0.113(*)
Change in SAT Math Average	-0.045	0.016
Change in SAT Verbal Average	-0.020	0.069

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

In our other report (21PSTEM, 2010), we look at the changes in 11th grade PSSA from 2004 to 2010. Although we can only compare with changes from 2004 to 2009 in regard to expenditures, we have some divergent findings. Change in instructional expenditures is actually negatively associated with change in PSSA math and reading passing rates, whereas it was small but positive over the shorter period of time from 2007 to 2009.

Table 13a: Correlations between Change in District Expenditures and Achievement from 2004 to 2009/2010

	Change in Total Expenditures from 2004 - 2009	Change in Instructional Expenditures from 2004 - 2009
Change in PSSA Math Passing Rate from 2004-2010	-0.074	-0.195(**)
Change in PSSA Reading Passing Rate from 2004-2010	-0.071	-0.202(**)

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

8. Discussion and Conclusions

The findings contained in this report and other cited above may at first leave policymakers in somewhat of a quandary. What alternatives are available to increased spending? One alternative 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). Thus, from a strategic standpoint, investing in preschool and Kindergarten at least in theory could make sense.

In our National Science Foundation funded 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 (New Jersey state test) scores by 34% points in relation to comparably matched schools. However, some schools in our sample actually *declined* by the same amount that others had increased. 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 & Jantzi, 2000; Hallinger, 2000; and 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.

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Public Data Sources

PDE website (<http://www.education.state.pa.us/>):

- PSSA scores, by district, for 11th grade math, reading, and science (2007-2010)
- SAT scores, by district and high school (2007-2009)
- District financial information, by district (2007-2009)
- Average Daily Membership (2007-2009)

School Matters website (<http://www.schoolmatters.com/> and <http://www.schooladatadirect.org/>)

- % Bachelors (2006)
- % eligible for free or reduced lunch, by district (2006)
- % Low household income (2006)
- School enrollments by race (2006)

Appendix 1: Correlations *within* the Set of Input and Outcome Variables

This appendix looks explores the relationship between the set of input and outcome variables used in the above report. We looked at the correlations *within* the input variables. For example, there is strong *negative* correlation between the percentage of the community with a Bachelors degree and poverty, that is, the greater the extent of poverty the smaller percent of the community holding a Bachelors degree. Throughout the appendices, strong relationship are indicated through bolding.

2006-2007 Inter-Correlations of Input Variables

Pearson Correlation	% eligible for free or reduced lunch	% of White students	% with bachelors in the community	Total Expenditure per ADM 06-07	Instructional Expenditure per ADM 06-07
% eligible for free or reduced lunch	1				
% of students that are White	-.429(**)	1			
% with bachelors in the community	-.605(**)	-.150(**)	1		
Total Expenditure per ADM 06-07	-.017	-.280(**)	.436(**)	1	
Instructional Exp per ADM 06-07	.106(*)	-.435(**)	.376(**)	.833(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2007-2008 Inter-Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of White students	% with bachelors in the community	Total Expenditure per ADM 07-08	Instructional Expenditure per ADM 07-08
% eligible for free or reduced lunch	1				
% of students that are White	-.429(**)	1			
% with bachelors in the community	-.605(**)	-.150(**)	1		
Total Exp per ADM 07-08	.012	-.239(**)	.362(**)	1	
Instructional Expenditure per ADM 07-08	.110(*)	-.450(**)	.376(**)	.759(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2008-2009 Inter-Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of White students	% with bachelors in the community	Total Expenditure per ADM 08-09	Instructional expenditure per ADM 08-09
% eligible for free or reduced lunch	1				
% of students that are White	-.429(**)	1			
% with bachelors in the community	-.605(**)	-.150(**)	1		
Total Exp per ADM 08-09	-.020	-.302(**)	.409(**)	1	
Instructional Expenditure per ADM 08-09	.123(**)	-.471(**)	.357(**)	.802(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

Appendix 2: Correlations Within The Set of Student Outcomes Variables:

In this appendix, we correlate the student outcome variables to each other: SAT and PSSA for 2007, 2008, and 2009. All of the correlations show strong positive relationships. Almost every correlation coefficient is above .70, indicating that all of the tests are strongly related to each other. We correlate a given PSSA test with the related SAT subtest in the same and *following* year. Since PSSA is taken in 11th grade, we wanted to see how it related to SAT in that year and the next, to make sure we were comparing the right people. Both 11th and 12th graders take the SAT. As it ends up, everything is strongly related. PSSAs, throughout, have slightly stronger relationships to the following year's SAT scores. The last thing correlated is SATs with Below Basic scores on the PSSA math and reading. As might be expected there is a strong negative correlations between SAT score. All correlations show strong relationships in the direction that would be expected.

2007 Math PSSA and 2007/2008 Math SAT Correlations

Pearson Correlation	Average 2007 SAT Math	Average 2008 SAT Math	Percent Pro & Adv on math 2007	Percent Adv on math 2007
Average 2007 SAT Math	1			
Average 2008 SAT Math	.886(**)	1		
Percent Pro & Adv on math 2007	.759(**)	.794(**)	1	
Percent Adv on math 2007	.740(**)	.800(**)	.886(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2007 Reading PSSA and 2007/2008 Verbal SAT Correlations

Pearson Correlation	Average 2007 SAT Verbal	Average 2008 SAT Verbal	Percent Pro & Adv on reading 2007	Percent Adv on reading 2007
Average 2007 SAT Verbal	1			
Average 2008 SAT Verbal	.871(**)	1		
Percent Pro & Adv on reading 2007	.694(**)	.716(**)	1	
Percent Adv on reading 2007	.725(**)	.787(**)	.873(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2008 Math PSSA and 2008/2009 Math SAT Correlations

Pearson Correlation	Average 2008 SAT Math	Average 2009 SAT Math	Percent Pro & Adv on math 2008	Percent Adv on math 2008
Average 2008 SAT Math	1			
Average 2009 SAT Math	.881(**)	1		
Percent Pro & Adv on math 2008	.705(**)	.794(**)	1	
Percent Adv on math 2008	.710(**)	.795(**)	.885(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2008 Reading PSSA and 2008/2009 Verbal SAT Correlations

Pearson Correlation	Average 2008 SAT Verbal	Average 2009 SAT Verbal	Percent Pro & Adv on reading 2008	Percent Adv on reading 2008
Average 2008 SAT Verbal	1			
Average 2009 SAT Verbal	.876(**)	1		
Percent Pro & Adv on reading 2008	.701(**)	.735(**)	1	
Percent Adv on reading 2008	.693(**)	.762(**)	.891(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2008 Science PSSA and 2008/2009 Math SAT Correlations

Pearson Correlation	Average 2008 SAT Math	Average 2009 SAT Math	Percent Pro & Adv on science 2008	Percent Adv on science 2008
Average 2008 SAT Math	1			
Average 2009 SAT Math	.881(**)	1		
Percent Pro & Adv on science 2008	.730(**)	.786(**)	1	
Percent Adv on science 2008	.709(**)	.760(**)	.866(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2009 Math PSSA and 2009 Math SAT Correlations

Pearson Correlation	Average 2009 SAT Math	Percent Pro & Adv on math 2009	Percent Adv on math 2009
Average 2009 SAT Math	1		
Percent Pro & Adv on math 2009	.728(**)	1	
Percent Adv on math 2009	.730(**)	.876(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2009 Reading PSSA and 2009 Verbal SAT Correlations

Pearson Correlation	Average 2009 SAT Verbal	Percent Pro & Adv on reading 2009	Percent Adv on reading 2009
Average 2009 SAT Verbal	1		
Percent Pro & Adv on reading 2009	.723(**)	1	
Percent Adv on reading 2009	.714(**)	.885(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2009 Science PSSA and 2009 Math SAT Correlations

Pearson Correlation	Average 2009 SAT Math	Percent Pro & Adv on science 2009	Percent Adv on science 2009
Average 2009 SAT Math	1		
Percent Pro & Adv on science 2009	.740(**)	1	
Percent Adv on science 2009	.716(**)	.914(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2007-2009 Percentage Below Basic on PSSA Math and 2007-2009 SAT Correlations

	Average 2007 SAT Math	Average 2008 SAT Math	Average 2009 SAT Math	Percent Below Basic math 2007	Percent Below Basic math 2008	Percent Below Basic math 2009
Pearson Correlation						
Percent Below Basic math 2007	-.742(**)	-.746(**)	-.745(**)	1		
Percent Below Basic math 2008	-.698(**)	-.697(**)	-.761(**)	.801(**)	1	
Percent Below Basic math 2009	-.722(**)	-.709(**)	-.713(**)	.781(**)	.792(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2007-2009 Percentage Below Basic on PSSA Reading and 2007-2009 SAT Verbal Correlations

	Average 2007 SAT Verbal	Average 2008 SAT Verbal	Average 2009 SAT Verbal	Percent Below Basic reading 2007	Percent Below Basic reading 2008	Percent Below basic reading 2009
Pearson Correlation						
Percent Below Basic reading 2007	-.656(**)	-.669(**)	-.658(**)	1		
Percent Below Basic reading 2008	-.672(**)	-.666(**)	-.678(**)	.803(**)	1	
Percent Below Basic reading 2009	-.669(**)	-.684(**)	-.669(**)	.767(**)	.747(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

2008-2009 Percentage Below Basic on PSSA Science and 2007-2009 SAT Math Correlations

	Average 2008 SAT Math	Average 2009 SAT Math	Percent Below basic science 2008	Percent Below basic science 2009
Pearson Correlation				
Percent Below Basic science 2008	-.643(**)	-.665(**)	1	
Percent Below Basic science 2009	-.669(**)	-.676(**)	.817(**)	1

** Correlation is significant at the 0.01 level (2-tailed)

Appendix 3: Correlations between Inputs and All Student Outcome Variables

The following appendix explores correlations between all of the input variables and all of the student outcome variables (including % below basic, % advanced, and % proficient and advanced for PSSA). The two expenditure variables have weak to virtually non-existent correlations to PSSA math and reading results for all three years: 2007, 2008 and 2009. The strongest positive relationship to Proficient and Advanced math PSSA scores is the percentage of people with 4 year college degrees in the community. The strongest negative correlation to PSSA scores is the percent of students eligible for free or reduced lunch.

The data does not support the hypothesis that the data might be related in some non-linear manner (cubic or logistic, as examples). A linear regression line was still fit to the data and shows a miniscule rise in scores given significant increases in Total Expenditure per Pupil. This analysis is very similar for all of the remaining plots.

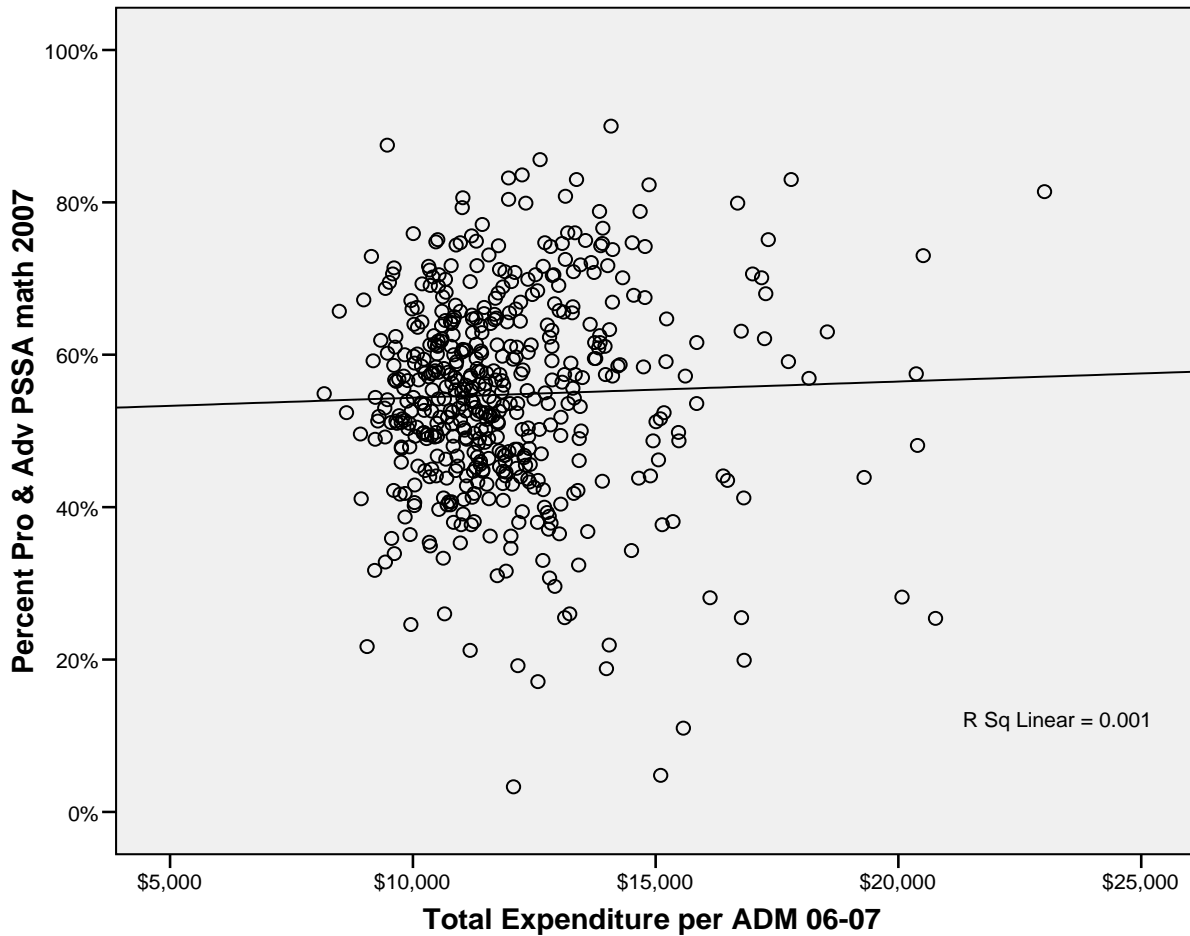
The tables and scatterplots that follow show how relatively unrelated Total Expenditures are to achievement when not controlling for any other variables. Total Expenditure per ADM is on the horizontal axis and Percentage Proficient and Advanced is on the vertical axis. There are 498 points, one pair of data (expenditure and corresponding percent pro/adv on the 2007 PSSA math) from each school district.

The regression coefficient for the relationship between total expenditures and percent passing on the 2007 PSSA Math was .033, and the corresponding coefficient of determination (what is written as “R Sq Linear” on the page because this is the correlation coefficient, r , squared) is .001. This indicates that these variables do not relate to each other. This can be seen in the data which is mostly random.

2007 PSSA Math Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 2006-07	Instructional Expenditure per ADM 2006-07
Percent Pro & Adv on math 2007	-.666(**)	.379(**)	.554(**)	.033	-.071
Percent Adv on math 2007	-.632(**)	.202(**)	.691(**)	.130(**)	.038
Percent Below basic math 2007	.671(**)	-.497(**)	-.443(**)	.029	.135(**)

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).



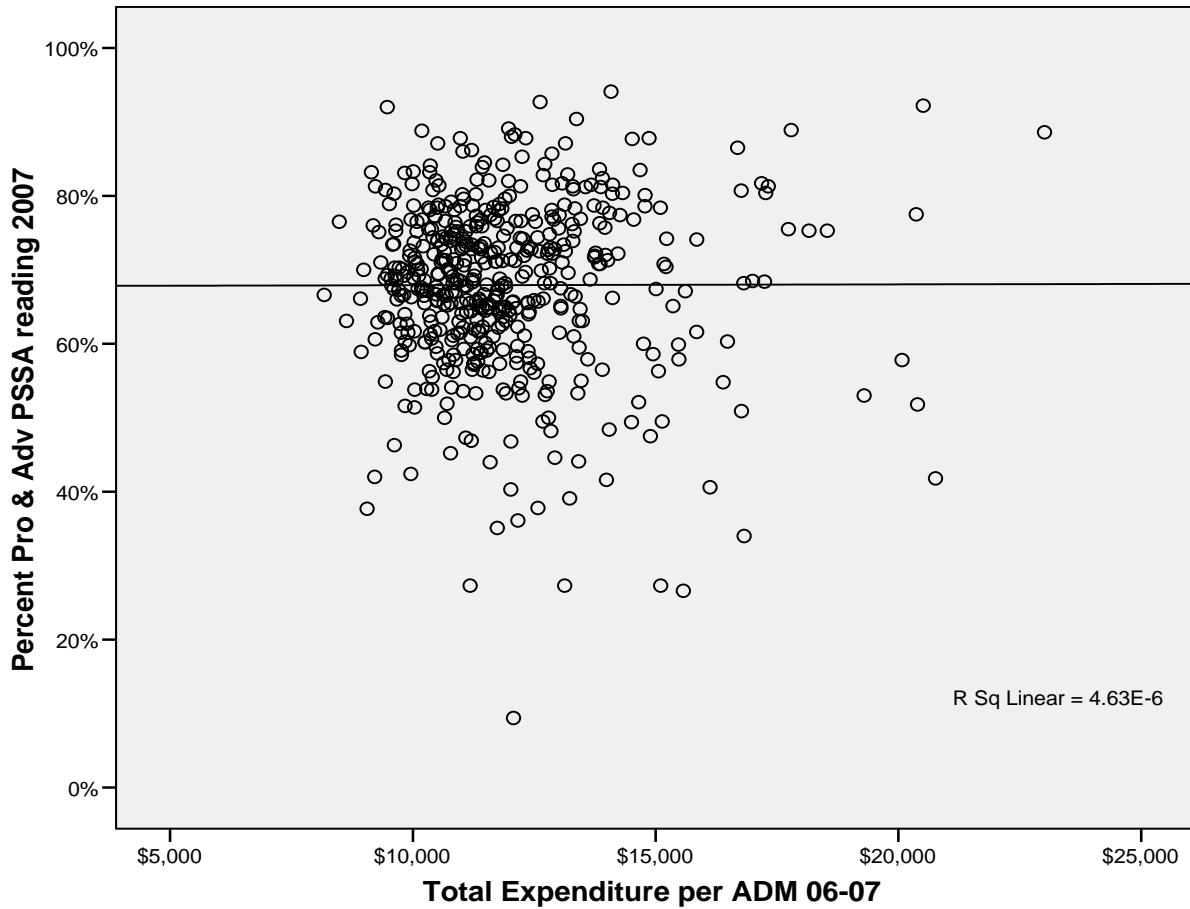
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2007 PSSA Reading Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 2006-07	Instructional expenditure per ADM 2006-07
Percent Pro & Adv on reading 2007	-.672(**)	.475(**)	.486(**)	.002	-.107(*)
Percent Adv on reading 2007	-.657(**)	.289(**)	.638(**)	.083	-.013
Percent Below basic reading 2007	.629(**)	-.543(**)	-.387(**)	.056	.157(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

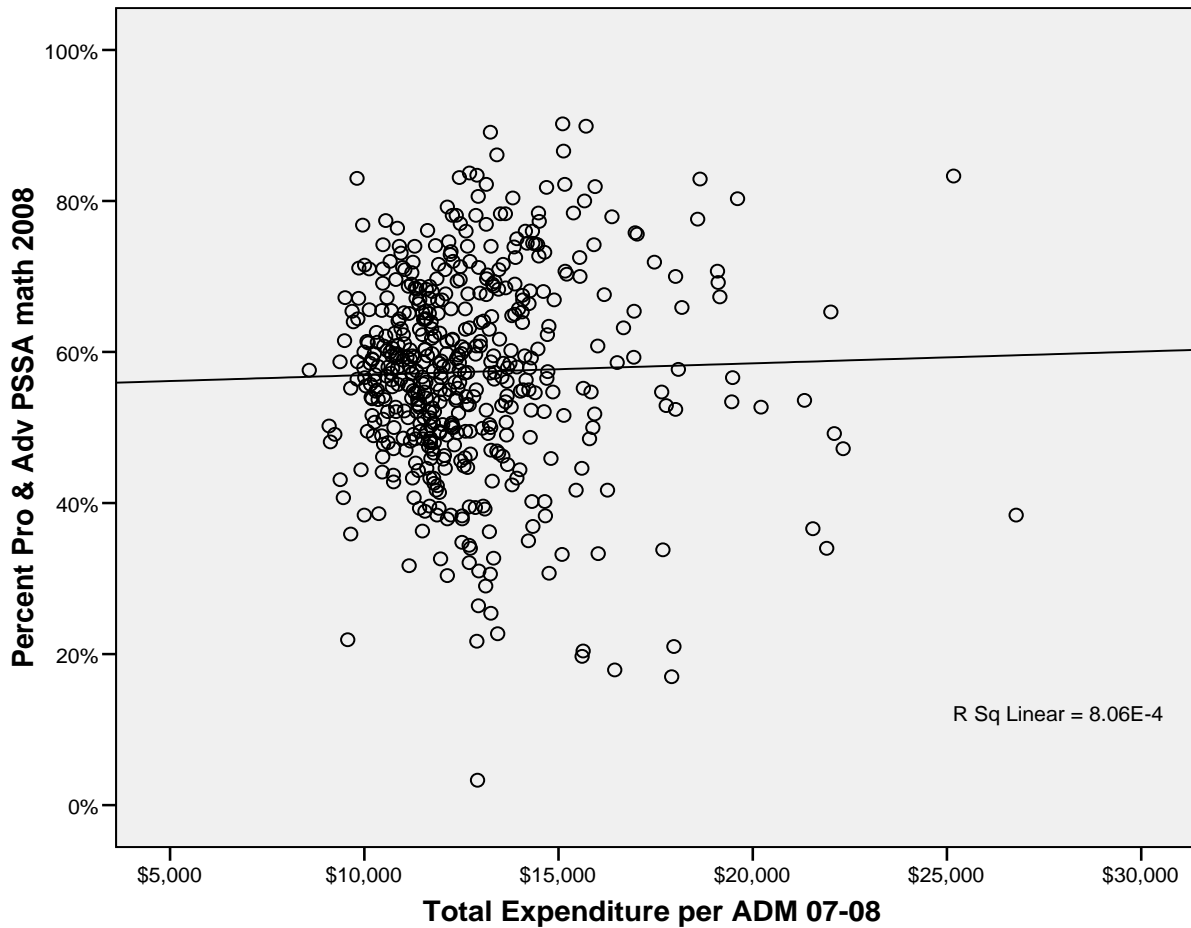


2008 PSSA Math Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 07-08	Instructional expenditure per ADM 07-08
Percent Pro & Adv on math 2008	-.661(**)	.393(**)	.536(**)	.028	-.055
Percent Adv on math 2008	-.606(**)	.221(**)	.659(**)	.090(*)	.045
Percent Below basic math 2008	.658(**)	-.534(**)	-.427(**)	.001	.123(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

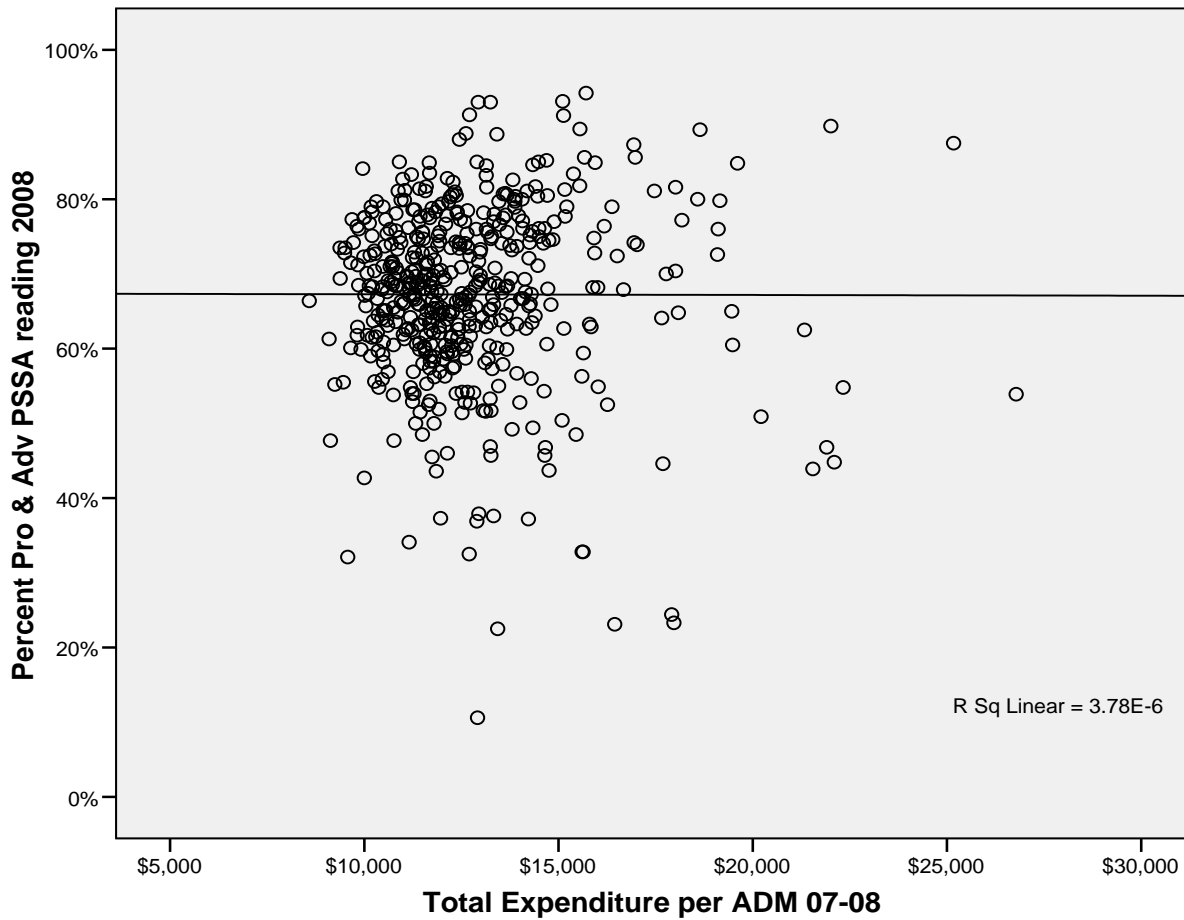


2008 PSSA Reading Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 2007-08	Instructional expenditure per ADM 2007-08
Percent Pro & Adv on reading 2008	-.695(**)	.498(**)	.504(**)	-.002	-.101(*)
Percent Adv on reading 2008	-.654(**)	.313(**)	.648(**)	.103(*)	.034
Percent Below basic reading 2008	.646(**)	-.588(**)	-.389(**)	-.001	.153(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

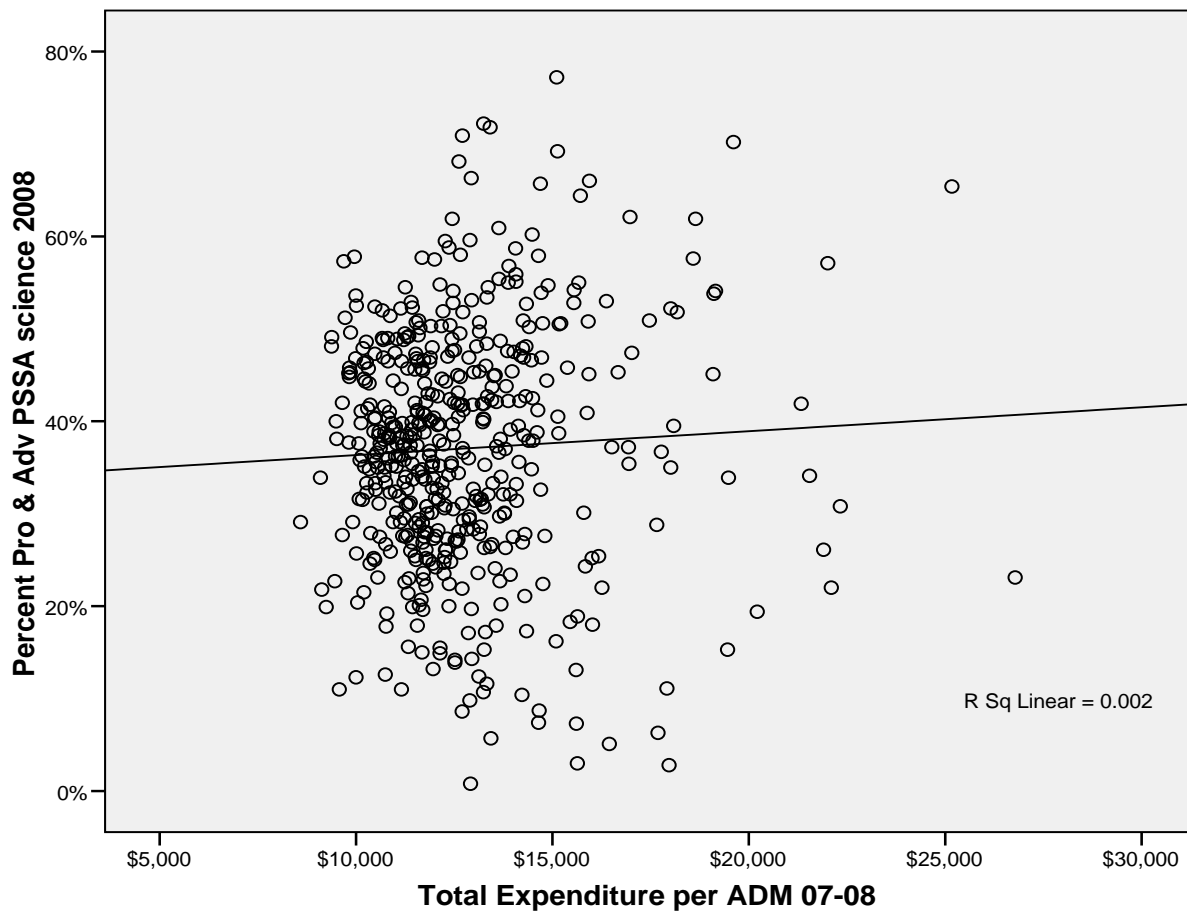


2008 PSSA Science Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 2007-08	Instructional expenditure per ADM 2007-08
Percent Pro & Adv on science 2008	-.679(**)	.430(**)	.546(**)	.048	-.088(*)
Percent Adv on science 2008	-.636(**)	.219(**)	.671(**)	.102(*)	.037
Percent Below basic science 2008	.637(**)	-.699(**)	-.258(**)	.071	.274(**)

** Correlation is significant at the 0.01 level (2-tailed).

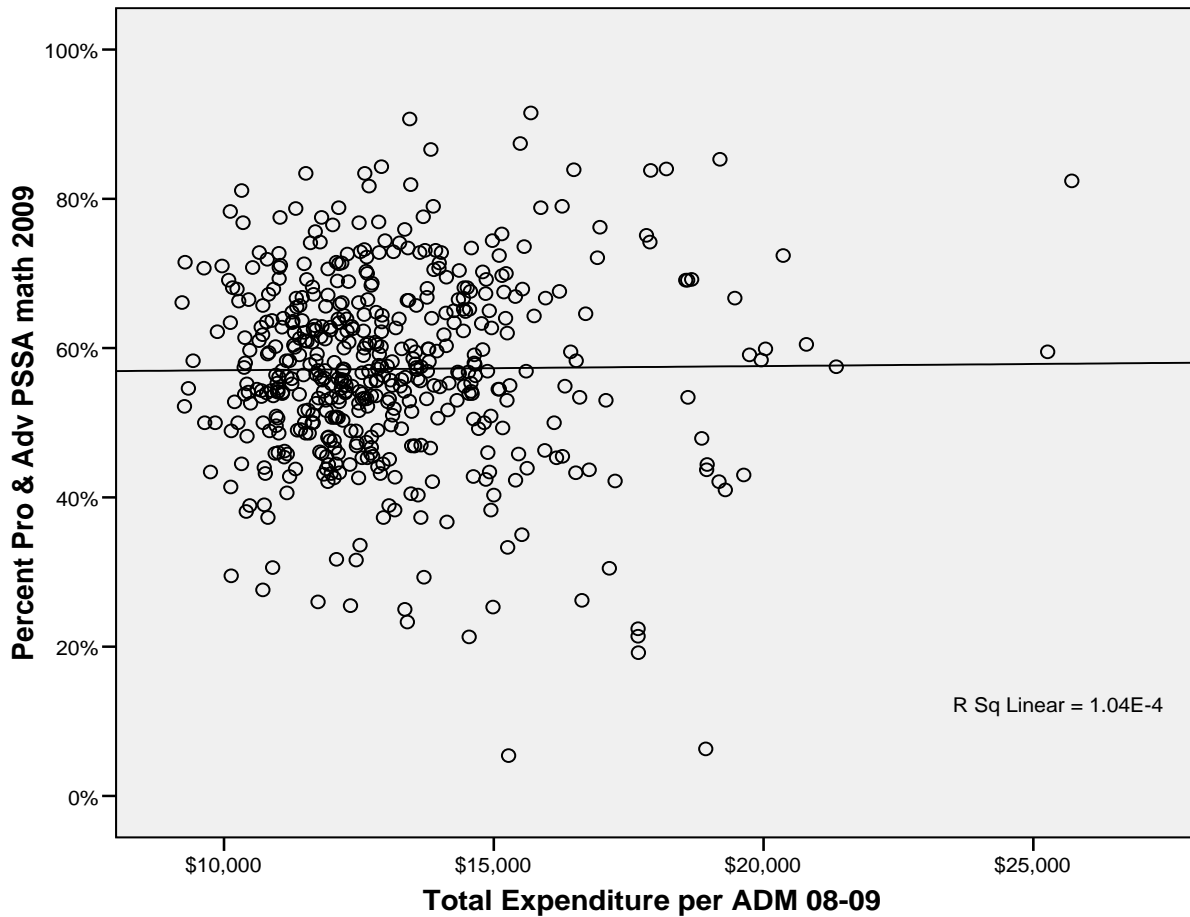
* Correlation is significant at the 0.05 level (2-tailed).



2009 PSSA Math Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 08-09	Instructional expenditure per ADM 08-09
Percent Pro & Adv on math 2009	-.645(**)	.401(**)	.533(**)	.010	-.107(*)
Percent Adv on math 2009	-.614(**)	.226(**)	.656(**)	.121(**)	.032
Percent Below basic math 2009	.658(**)	-.512(**)	-.428(**)	.044	.177(**)

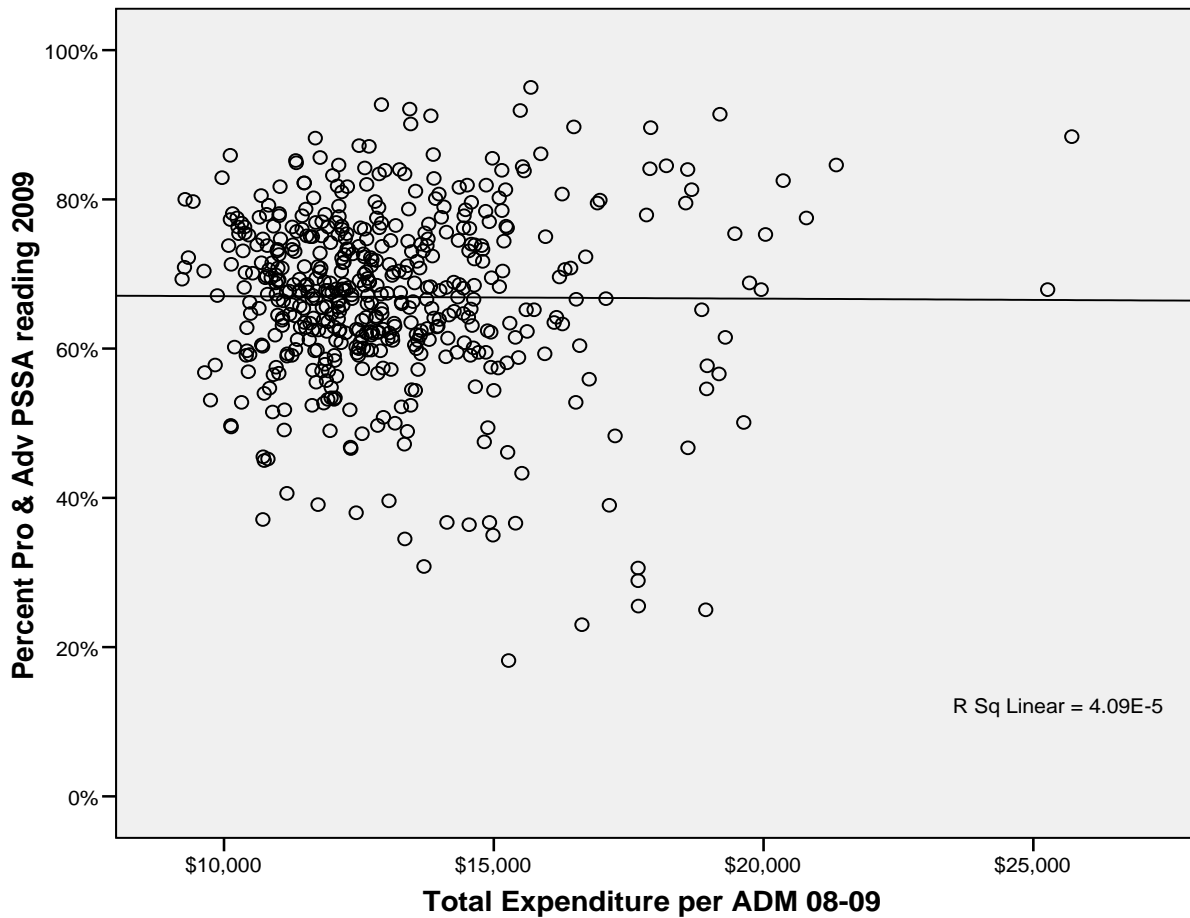
** Correlation is significant at the 0.01 level (2-tailed).
 * Correlation is significant at the 0.05 level (2-tailed).



2009 PSSA Reading Correlations

	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 08-09	Instructional expenditure per ADM 08-09
Pearson Correlation					
Percent Pro & Adv on reading 2009	-.711(**)	.458(**)	.544(**)	-.006	-.138(**)
Percent Adv on reading 2009	-.673(**)	.286(**)	.666(**)	.123(**)	.007
Percent Below basic reading 2009	.675(**)	-.495(**)	-.450(**)	.037	.167(**)

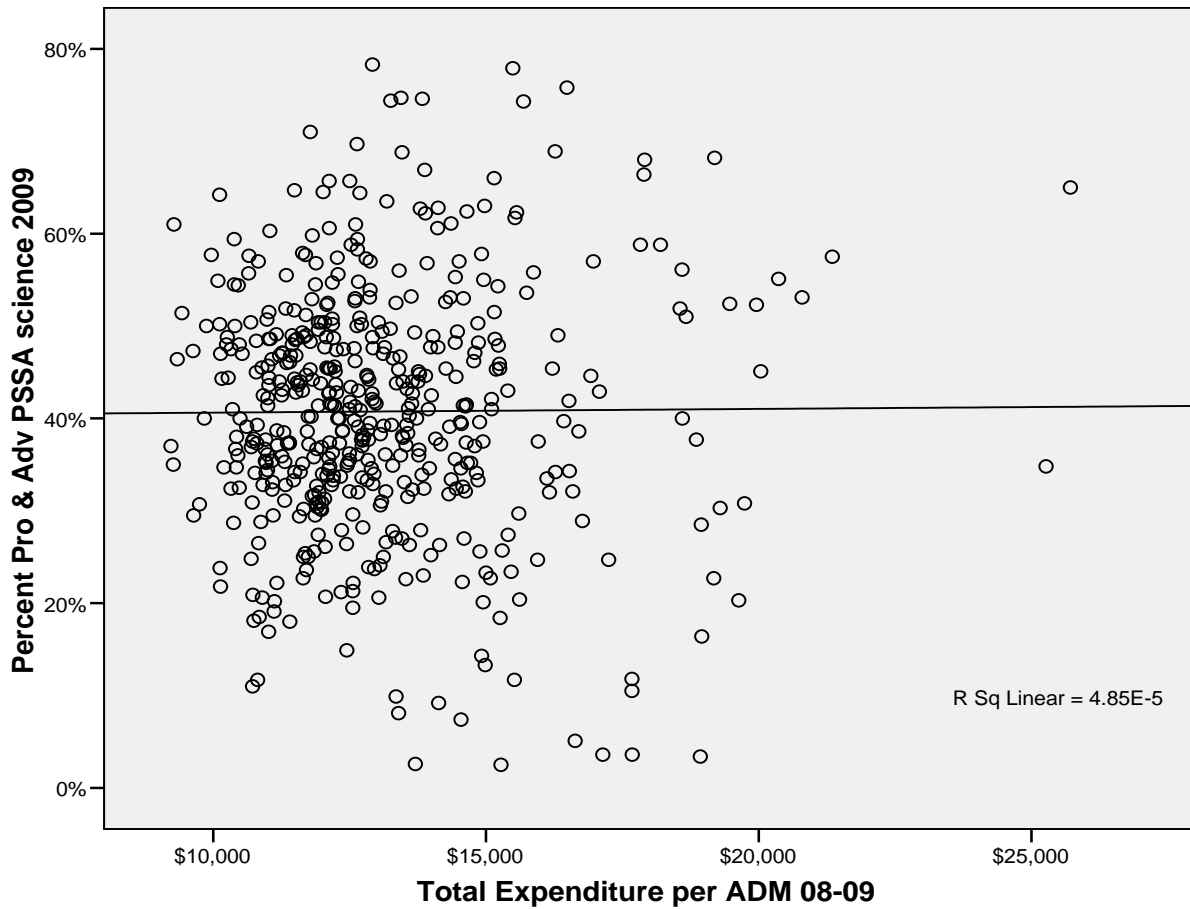
** Correlation is significant at the 0.01 level (2-tailed).



2009 PSSA Science Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 08-09	Instructional expenditure per ADM 08-09
Percent Pro & Adv on science 2009	-.692(**)	.436(**)	.567(**)	.007	-.117(**)
Adv on science 2009	-.648(**)	.279(**)	.659(**)	.102(*)	.003
Percent Below basic science 2009	.660(**)	-.709(**)	-.296(**)	.117(**)	.279(**)

** Correlation is significant at the 0.01 level (2-tailed).
 * Correlation is significant at the 0.05 level (2-tailed).



The following correlations are between SAT scores and the same independent variables. The relationships between the independent variables and SAT scores are very stable from 2007 to 2009. The correlations are almost the same in corresponding cells of the 2007, 2008 and 2009 school year tables. All of the expenditure variables are uncorrelated with SAT scores. Poverty has a strong negative relationship to average SAT scores on either subtest. Percentage of White students has a moderate positive relationship to average SAT scores on both subtests, and percentage of community members with four-year degrees has a strong positive relationship with both SAT subtests. More simply put, the higher the percentage students eligible for free or reduced lunch, on average, the lower average SAT scores are in the districts, and the higher the percentage of White students and community members with bachelors degrees the higher the average SAT scores are, and vice versa.

2007 -2009 SAT Math Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 06-07	Instructional expenditure per ADM 06-07
Average 2007 SAT Math	-.772(**)	.448(**)	.614(**)	.048	-.064
Average 2008 SAT Math	-.761(**)	.442(**)	.624(**)	.060	-.074
Average 2009 SAT Math	-.751(**)	.429(**)	.634(**)	.075	-.020

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

2007 – 2009 SAT Verbal Correlations

Pearson Correlation	% eligible for free or reduced lunch	% of students that are White	% with bachelors in the community	Total Expenditure per ADM 07-08	Instructional expenditure per ADM 07-08
Average 2007 SAT Verbal	-.769(**)	.432(**)	.616(**)	.066	-.049
Average 2008 SAT Verbal	-.761(**)	.425(**)	.613(**)	.050	-.088
Average 2009 SAT Verbal	-.757(**)	.431(**)	.627(**)	.094(*)	-.015

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix 4: Disaggregated Expenditures and Student Outcomes

The following appendix explores correlations between the disaggregated expenditures and all of the student outcome variables (including % below basic, % advanced, and % proficient and advanced for PSSA).

Correlations - Disaggregated Expenditures and 2009 PSSA Math and Reading

Year 2009	Percent Adv on math	Percent Pro & Adv on math	Percent Below Basic math	Percent Adv on reading	Percent Pro & Adv on reading	Percent Below Basic reading
Total Exp.	.121(**)	.010	.044	.123(**)	-.006	.037
Instructional Exp.	.032	-.107(*)	.177(**)	.007	-.138(**)	.167(**)
Regular Education Exp.	.180(**)	.062	.009	.180(**)	.045	-.019
Special Education Exp.	-.002	-.147(**)	.225(**)	-.031	-.177(**)	.211(**)
Vocational Education Exp.	-.269(**)	-.208(**)	.117(**)	-.241(**)	-.180(**)	.158(**)
Other Education Exp.	-.236(**)	-.270(**)	.263(**)	-.333(**)	-.312(**)	.312(**)
All Support Services Exp.	.146(**)	.065	-.012	.173(**)	.054	-.022
Student Support Exp.	.252(**)	.174(**)	-.128(**)	.277(**)	.168(**)	-.146(**)
Teacher Support Exp.	.152(**)	.118(**)	-.090(*)	.165(**)	.095(*)	-.073
School Library Exp.	.241(**)	.240(**)	-.250(**)	.255(**)	.239(**)	-.233(**)
Administrative Exp.	.014	-.010	.035	-.013	-.074	.088
Superintendent Exp.	-.113(*)	-.091(*)	.093(*)	-.135(**)	-.164(**)	.146(**)
Principal Exp.	.130(**)	.079	-.057	.100(*)	.036	-.027
Non-instructional Exp.	.087	.081	-.056	.064	.042	-.058
Sports and Extracurr. Exp.	.114(*)	.145(**)	-.155(**)	.122(**)	.140(**)	-.162(**)
Community Service Exp.	-.051	-.122(*)	.195(**)	-.117(*)	-.203(**)	.215(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Science testing is relatively new to Pennsylvania but correlations on this table are very similar to previous. The same trends of positive relationship between support spending and school sports and achievement, and negative relationships between non-regular education spending and achievement occur throughout. Notice also where there are some subcomponents without

relationships to achievement, including non-instructional, administrative, and to some extent regular education and total expenditures.

Correlations - Disaggregated Expenditures and 2009 PSSA Science

Year 2009	Percent Pro & Adv on science	Percent Adv on science	Percent Below basic science 2009
Total Exp.	.007	.102(*)	.117(**)
Instructional Exp.	-.117(**)	.003	.279(**)
Regular Education Exp.	.054	.154(**)	.095(*)
Special Education Exp.	-.139(**)	-.025	.345(**)
Vocational Education Exp.	-.181(**)	-.231(**)	.028
Other Education Exp.	-.321(**)	-.267(**)	.324(**)
All Support Services Exp.	.075	.144(**)	.031
Student Support Exp.	.174(**)	.250(**)	-.009
Teacher Support Exp.	.140(**)	.194(**)	-.053
School Library Exp.	.280(**)	.269(**)	-.278(**)
Administrative Exp.	-.040	-.018	.057
Superintendent Exp.	-.104(*)	-.120(**)	-.002
Principal Exp.	.040	.092(*)	.042
Non-instructional Exp.	.045	.021	-.044
Sports and Extracurric. Exp.	.125(**)	.063	-.167(**)
Community Service Exp.	-.172(**)	-.094(*)	.243(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

SAT averages have very similar relationships to expenditures as the PSSA tests (as previously described in the report), only slightly stronger:

- Spending with no relationship to SAT scores
 - Total expenditure, instruction, special education, administrative, principal office, non-instructional, and school sports and extracurriculars.
- Spending with weak positive correlations to aptitude:
 - Regular program, support services, pupil support, and instructional staff support.
- Spending with a weak negative correlations to aptitude:
 - Vocational education, office of the superintendent, and community service.
- School library spending has the largest positive correlation with SAT, a MODERATE positive correlation with aptitude.
- Other educational spending (including driver’s education, summer school, etc.) has the largest negative correlation with SAT, a MODERATE negative correlation with aptitude.

Disaggregated Expenditures and SAT Correlations

Year 2009	Average 2009 SAT Verbal	Average 2009 SAT Math
Total Exp.	.094(*)	.075
Instructional Exp.	-.015	-.020
Regular Education Exp.	.161(**)	.150(**)
Special Education Exp.	-.069	-.067
Vocational Education Exp.	-.189(**)	-.195(**)
Other Education Exp.	-.313(**)	-.307(**)
All Support Services Exp.	.125(**)	.106(*)
Student Support Exp.	.270(**)	.274(**)
Teacher Support Exp.	.158(**)	.156(**)
School Library Exp.	.346(**)	.341(**)
Administrative Exp.	-.058	-.057
Superintendent Exp.	-.128(**)	-.142(**)
Principal Exp.	.067	.071
Non-instructional Exp.	.024	.009
Sports and Extracurric. Exp.	.116(*)	.088
Community Service Exp.	-.200(**)	-.189(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix 5: Disaggregated Expenditure Rates and Student Outcomes

The following appendix explores correlations between the disaggregated expenditures rates (the ratio of each subcategory of spending to Total Expenditures) and all of the student outcome variables (including % below basic, % advanced, and % proficient and advanced for PSSA).

Disaggregated Expenditure Rates and PSSA Math Correlations

Year 2009	Percent Adv on math	Percent Pro & Adv on math	Percent Below Basic math
Instructional Rate	-.179(**)	-.208(**)	.227(**)
Regular Education Rate	.073	.085	-.066
Special Education Rate	-.114(*)	-.218(**)	.280(**)
Vocational Education Rate	-.278(**)	-.202(**)	.102(*)
Other Education Rate	-.220(**)	-.232(**)	.209(**)
All Support Services Rate	.042	.085	-.086
Student Support Rate	.208(**)	.190(**)	-.161(**)
Teacher Support Rate	.112(*)	.119(**)	-.113(*)
School Library Rate	.174(**)	.232(**)	-.275(**)
Administrative Rate	-.093(*)	-.021	-.005
Superintendent Rate	-.154(**)	-.090(*)	.075
Principal Rate	.024	.078	-.114(*)
Non-instructional Rate	.035	.071	-.069
Sports and Extracurric. Rate	.054	.125(**)	-.155(**)
Community Service Rate	-.054	-.114(*)	.181(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Disaggregated Expenditure Rates and PSSA Reading Correlations

	Percent Pro & Adv on reading 2009	Percent Adv on reading 2009	Percent Below basic reading 2009
Instructional Rate	-.227(**)	-.215(**)	.227(**)
Regular Education Rate	.089(*)	.084	-.092(*)
Special Education Rate	-.246(**)	-.153(**)	.266(**)
Vocational Education Rate	-.164(**)	-.250(**)	.143(**)
Other Education Rate	-.266(**)	-.312(**)	.262(**)
All Support Services Rate	.100(*)	.096(*)	-.093(*)
Student Support Rate	.184(**)	.237(**)	-.178(**)
Teacher Support Rate	.095(*)	.113(*)	-.088
School Library Rate	.240(**)	.184(**)	-.253(**)
Administrative Rate	-.074	-.119(**)	.065
Superintendent Rate	-.153(**)	-.174(**)	.124(**)
Principal Rate	.046	-.003	-.064
Non-instructional Rate	.042	.016	-.066
Sports and Extracurric. Rate	.128(**)	.064	-.157(**)
Community Service Rate	-.191(**)	-.119(*)	.200(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Disaggregated Expenditure Rates and PSSA Science Correlations

Pearson Correlation	Percent Pro & Adv on science 2009	Percent Adv on science 2009	Percent Below basic science 2009
Instructional Rate	-.229(**)	-.193(**)	.268(**)
Regular Education Rate	.070	.067	-.053
Special Education Rate	-.206(**)	-.130(**)	.374(**)
Vocational Education Rate	-.170(**)	-.235(**)	.004
Other Education Rate	-.286(**)	-.250(**)	.259(**)
All Support Services Rate	.102(*)	.070	-.126(**)
Student Support Rate	.184(**)	.214(**)	-.063
Teacher Support Rate	.136(**)	.161(**)	-.092(*)
School Library Rate	.273(**)	.209(**)	-.332(**)
Administrative Rate	-.055	-.113(*)	-.032
Superintendent Rate	-.106(*)	-.156(**)	-.036
Principal Rate	.033	-.001	-.064
Non-instructional Rate	.038	-.022	-.080
Sports and Extracurric. Rate	.108(*)	.014	-.190(**)
Community Service Rate	-.166(**)	-.099(*)	.225(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Disaggregated Expenditure Rates and SAT Correlations

Pearson Correlation	Average 2009 SAT Verbal	Average 2009 SAT Math
Instructional Rate	-.197(**)	-.174(**)
Regular Education Rate	.088(*)	.097(*)
Special Education Rate	-.178(**)	-.162(**)
Vocational Education Rate	-.184(**)	-.181(**)
Other Education Rate	-.283(**)	-.272(**)
All Support Services Rate	.055	.049
Student Support Rate	.241(**)	.258(**)
Teacher Support Rate	.129(**)	.133(**)
School Library Rate	.292(**)	.296(**)
Administrative Rate	-.153(**)	-.132(**)
Superintendent Rate	-.156(**)	-.157(**)
Principal Rate	-.020	.003
Non-instructional Rate	-.016	-.028
Sports and Extracurric. Rate	.061	.037
Community Service Rate	-.191(**)	-.179(**)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix 6: Multiple Regression Models and Summaries

The following appendix explores regression models based on our education production formula and 14 outcome measures (percent Proficient and Advanced on PSSA math, science and reading from 2007 to 2009, and SAT math and verbal from 2007 to 2009).

In the following analyses, the size of the district was included as a covariate. Like expenditures, this variable changed in the model to match the year of the test. By including district size in the model we controlled for its effect on the model. While other variables might be removed from a model when they were non-significant, district size (ADM) was always included. This was done to account for a previous limitation: since our work was at the district level we missed the effect of district size on achievement.

We ran enter linear regressions based on the education production formula listed previously. Variables were removed from the model if the p-level for a variable was above 0.10, which indicates that there is a greater than 10% chance that the contribution of that variable is no different than 0. We also used tolerance coefficients to protect against multicollinearity. Multicollinearity occurs when the variability in one independent variable can be mostly explained by the rest of the independent variables. We used an industry standard that if the tolerance was below 0.30, we discarded the variable from the model due to multicollinearity. We did not have issues with multicollinearity in any model. Percent eligible for free or reduced lunch was related to the other variables, but its tolerance was always above 0.30.

We list all of the models first, and then bring them together in summary tables at the end of the section for cross model comparisons. We analyze one of the individual models up front, and then save the rest of the analysis for the summary tables where the information is all together. The reader will notice the models are similar throughout. In total, the percent Bachelors and percent of White students make up the largest contributions to the model. Percent eligible for free or reduced lunch is smaller. Total expenditure per ADM has the smallest relative effect in the model. ADM is included to control for district size, but it is not analyzed.

Each model comes with three tables. The first includes the model “fit.” The model table has four pieces of information, but we will only look at the first two. “R,” also known as multiple-R, is a regression coefficient between all of the independent variables at once and the dependent variable. This term is not interpretable like the lowercase “r” in the previous correlation analyses. However, when you square multiple-R you get a coefficient of determination like you would with Pearson correlations, also called R-squared. R-squared is interpreted to be the proportion of variability in the dependent variable accounted for by the variability in all of the independent variables. R-squared is a fit statistic because it tells the reader how well the independent variables predict the dependent variable. The adjusted R-squared, the third number

in the table, includes a method to statistically control for the effect of number of regressors, and is very similar to R-squared. Many statisticians argue that R-squared tends to overestimate fit, but others disagree. Our models are small, and the difference is negligible. Given the debate and this minimum difference, we use R-squared to describe the fit of our models.

The second table lists an ANOVA test. This test is used to determine if the model is significant. All of our models are significant. While there is other information that can be gleaned from this table, we do not use it presently.

The third table lists two sets of regression coefficients (B and Beta), and their significance in the model using a t-statistic. B is what are called unstandardized regression coefficients. They are used to determine the practical effect of each variable in the model on the dependent variable while controlling for the other variables. Unstandardized regression coefficients can thus be considered the “effect size” of a given variable. They are interpreted as follows: an increase in of one unit in the independent variable would correspond with a change in the dependent variable by whatever the coefficient is, when holding all other variables constant. For example, say the independent variable is spending and the dependent variable is average SAT score. If B is 0.58, this would be interpreted to mean that an increase of one dollar would correspond with a rise of 0.58 in average SAT score, controlling for the other variables. One can multiply regression coefficients, which themselves are rates. Using the same example, a rise is \$1000 would result in rise in 580 points. If the coefficient is negative, this indicates that a rise in the independent variable would correspond with a drop in the dependent variable, while controlling for the other variables.

Beta is the standardized coefficient, and it identifies the relative importance of each independent variable in the model. Instead of using raw data, values of all of the independent and dependent variables are standardized (by subtracting the mean of a variable from each value and dividing by the standard deviation of the variable). This is done so that all of the variable will be comparable. Standardization makes the mean of every variable 0 and the standard deviation 1. This is important if one wants to look between the variables to see how they compare to each other in the model. Our models include percentages and dollars, so a comparison of the two does not make sense. However, once standardized, we can see the effect of one variable in relation to each other. Beta cannot be meaningfully interpreted vis-à-vis the dependent variable. For example, say a beta was -0.43, this would be read that an increase of one standardized unit of the independent variable would result in a decrease of 0.43 standardized units in the dependent variable. However, if one knows that one independent variable has a Beta of -0.43 and another has a beta of 0.037, one could say that the first variable contributes more than the second variable. Both B and Beta can be positive or negative.

The t-test and corresponding p-value lets the reader know whether an independent variable is a statistically significant contributor to a model. Notice that ADM is often not significant (but is left in to control for district size). Any other variable that is non-significant has been removed from the model. This happens three times, and it is always expenditure that is not significant. Notice that there is a variable called “constant” in every model. We do not interpret this. The constant is the point at which the regression line begins (and there is no constant when working with standardized coefficients). Now we move to the models themselves. We analyze the first model in depth, while comparisons between the models are done at the end of the section.

If you look across the B coefficients, you see that a raise of 10 in percentage eligible for free or reduced lunch, percentage White, and percentage bachelors has the following changes in percentage passing: down 1.7, up 2.75, and up 5.61. It looks like % bachelors is twice as important as % White and three times % eligible for free or reduced lunch. However, these coefficients are not comparable like this. This is due to the fact that the three variables are distributed differently, so it means something different to change one percentage point in White versus eligible for free or reduced lunch. In this comparison, you cannot include expenditure because it has a different metric. The Betas do allow us to compare the relative effect of each variable in the model, while holding all other independent variables constant: Percent eligible for free or reduced lunch has a beta of $-.199$, percentage White is $.351$, percentage bachelors is $.528$ and per pupil expenditure is $-.103$. Percent bachelors is relatively the largest contributor to the model, followed by percentage white, percent eligible for free or reduced lunch, and per pupil expenditure. Notice that the ratios between the Betas are not as large as the ratios between the Bs.

%**Pro/Adv Math PSSA 2007** predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.744(a)	.554	.549	8.91813

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	48540.418	5	9708.084	122.063	.000
Residual	39130.286	492	79.533		
Total	87670.704	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	30.484	5.028		6.062		.000
Percentage of student eligible for free or reduced lunch	-.170	.045	-.199	-3.815		.000
Percentage of students that are White	.275	.033	.351	8.365		.000
Percentage of local households with bachelors	.561	.055	.528	10.185		.000
Total Expenditure per ADM 06-07	-.001	.000	-.103	-2.873		.004
Average Daily Membership 2007	3.16E-005	.000	.023	.701		.484

a Dependent Variable: Percent Pro & Adv on math 2007

%Pro/Adv Reading PSSA 2007 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.755(a)	.570	.566	7.56412

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	37310.069	5	7462.014	130.419	.000(a)
Residual	28150.224	492	57.216		
Total	65460.293	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	43.067	4.265		10.098		.000
Percentage of student eligible for free or reduced lunch	-.157	.038	-.212	-4.144		.000
Percentage of students that are White	.286	.028	.423	10.275		.000
Percentage of local households with bachelors	.423	.047	.461	9.051		.000
Total Expenditure per ADM 06-07	.000	.000	-.084	-2.369		.018
Average Daily Membership 2007	-2.60E-005	.000	-.021	-.681		.496

a Dependent Variable: Percent Pro & Adv on reading 2007

%**Pro/Adv Math PSSA 2008** predicted by % F/R lunch eligible, % White, and % bachelors (exp non-sig)

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.733(a)	.538	.534	9.02528

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	46765.911	4	11691.478	143.532	.000
Residual	40157.636	493	81.456		
Total	86923.547	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	26.717	4.631		5.769		.000
Percentage of student eligible for free or reduced lunch	-.201	.044	-.236	-4.597		.000
Percentage of students that are White	.288	.033	.369	8.663		.000
Percentage of local households with bachelors	.470	.049	.445	9.505		.000
Average Daily Membership 2008	4.44E-005	.000	.032	1.000		.318

a Dependent Variable: Percent Pro & Adv on math 2008

%Pro/Adv Reading PSSA 2008 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.783(a)	.613	.609	7.41648

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	42861.224	5	8572.245	155.847	.000(a)
Residual	27062.027	492	55.004		
Total	69923.250	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	36.900	4.072		9.062	.000
Percentage of student eligible for free or reduced lunch	-.165	.037	-.216	-4.461	.000
Percentage of students that are White	.323	.027	.462	11.827	.000
Percentage of local households with bachelors	.439	.044	.463	9.873	.000
Total Expenditure per ADM 07-08	.000	.000	-.056	-1.770	.077
Average Daily Membership 2008	1.54E-006	.000	.001	.042	.967

a. Dependent Variable: Percent Pro & Adv on reading 2008

%Pro/Adv Science PSSA 2008 predicted by % F/R lunch eligible, % White, and % bachelors
(exp non-sig)

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.763(a)	.583	.579	8.41416

ANOVA(b)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	48763.086	4	12190.771	172.191	.000(a)
Residual	34903.439	493	70.798		
Total	83666.525	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	2.590	4.318		.600		.549
Percentage of student eligible for free or reduced lunch	-.177	.041	-.211	-4.332		.000
Percentage of students that are White	.318	.031	.415	10.264		.000
Percentage of local households with bachelors	.497	.046	.479	10.776		.000
Average Daily Membership 2008	1.62E-005	.000	.012	.391		.696

a Dependent Variable: Percent Pro & Adv on science 2008

%Pro/Adv Math PSSA 2009 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.735(a)	.541	.536	8.57474

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	42567.782	5	8513.556	115.789	.000
Residual	36174.897	492	73.526		
Total	78742.679	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	30.176	4.948		6.099	.000
Percentage of student eligible for free or reduced lunch	-.129	.042	-.159	-3.051	.002
Percentage of students that are White	.287	.032	.387	9.040	.000
Percentage of local households with bachelors	.536	.051	.533	10.457	.000
Total Expenditure per ADM 08-09	-.001	.000	-.094	-2.643	.008
Average Daily Membership 2009	9.38E-006	.000	.007	.219	.827

a Dependent Variable: Percent Pro & Adv on math 2009

%Pro/Adv Reading PSSA 2009 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.791(a)	.626	.622	7.21517

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	42903.528	5	8580.706	164.827	.000
Residual	25612.894	492	52.059		
Total	68516.423	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	43.261	4.163		10.392		.000
Percentage of student eligible for free or reduced lunch	-.182	.036	-.240	-5.108		.000
Percentage of students that are White	.277	.027	.400	10.366		.000
Percentage of local households with bachelors	.468	.043	.498	10.840		.000
Total Expenditure per ADM 08-09	.000	.000	-.094	-2.928		.004
Average Daily Membership 2009	-4.73E-006	.000	-.004	-.131		.896

a Dependent Variable: Percent Pro & Adv on reading 2009

%Pro/Adv Science PSSA 2009 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.788(a)	.622	.618	8.23594

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	54850.449	5	10970.090	161.728	.000
Residual	33372.694	492	67.831		
Total	88223.142	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	10.070	4.752		2.119	.035
Percentage of student eligible for free or reduced lunch	-.147	.041	-.171	-3.617	.000
Percentage of students that are White	.328	.031	.418	10.767	.000
Percentage of local households with bachelors	.605	.049	.568	12.281	.000
Total Expenditure per ADM 08-09	-.001	.000	-.103	-3.169	.002
Average Daily Membership 2009	4.03E-006	.000	.003	.098	.922

a. Dependent Variable: PSSA09_S_PA Percent Pro & Adv on science 2009

Average SAT Math 2007 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.846(a)	.715	.712	18.011

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	399063.175	5	79812.635	246.041	.000
Residual	158949.758	490	324.387		
Total	558012.933	495			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	431.196	10.232		42.144	.000
Percentage of student eligible for free or reduced lunch	-.623	.091	-.286	-6.855	.000
Percentage of students that are White	.740	.067	.375	11.093	.000
Percentage of local households with bachelors	1.443	.111	.538	12.970	.000
Total Expenditure per ADM 06-07	-.001	.000	-.090	-3.117	.002
Average Daily Membership 2007	-3.83E-005	.000	-.011	-.422	.674

a Dependent Variable: Average 2007 SAT Math

Average SAT Verbal 2007 predicted % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.838(a)	.703	.700	16.718

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	323653.232	5	64730.646	231.613	.000
Residual	136943.766	490	279.477		
Total	460596.998	495			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	431.956	9.497		45.484	.000
Percentage of student eligible for free or reduced lunch	-.601	.084	-.304	-7.134	.000
Percentage of students that are White	.624	.062	.348	10.073	.000
Percentage of local households with bachelors	1.268	.103	.520	12.277	.000
Total Expenditure per ADM 06-07	-.001	.000	-.072	-2.441	.015
Average Daily Membership 2007	-9.30E-005	.000	-.029	-1.103	.271

a Dependent Variable: Average 2007 SAT Verbal

Average SAT Math 2008 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.844(a)	.712	.709	18.687

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	423049.674	5	84609.935	242.282	.000
Residual	171467.392	491	349.221		
Total	594517.066	496			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	414.458	10.423		39.763		.000
Percentage of student eligible for free or reduced lunch	-.576	.093	-.257	-6.166		.000
Percentage of students that are White	.824	.069	.404	11.954		.000
Percentage of local households with bachelors	1.514	.112	.547	13.468		.000
Total Expenditure per ADM 07-08	-.001	.000	-.052	-1.869		.062
Average Daily Membership 2008	4.92E-005	.000	.014	.531		.596

a Dependent Variable: Average 2008 SAT Math

Average SAT Verbal 2008 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.830(a)	.689	.686	17.464

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	332243.232	5	66448.646	217.880	.000
Residual	149744.003	491	304.978		
Total	481987.235	496			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	427.498	9.741		43.888	.000
Percentage of student eligible for free or reduced lunch	-.607	.087	-.301	-6.954	.000
Percentage of students that are White	.652	.064	.355	10.123	.000
Percentage of local households with bachelors	1.267	.105	.509	12.057	.000
Total Expenditure per ADM 07-08	-.001	.000	-.060	-2.076	.038
Average Daily Membership 2008	-1.19E-005	.000	-.004	-.137	.891

a Dependent Variable: Average 2008 SAT Verbal

Average SAT Math 2009 predicted by % F/R lunch eligible, % White, % bachelors, and total expenditure per ADM

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.845(a)	.714	.711	18.627

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	421856.978	5	84371.396	243.179	.000
Residual	169312.450	488	346.952		
Total	591169.427	493			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	B	Std. Error
(Constant)	411.487	10.876		37.834	.000
Percentage of student eligible for free or reduced lunch	-.528	.093	-.231	-5.667	.000
Percentage of students that are White	.859	.070	.412	12.292	.000
Percentage of local households with bachelors	1.614	.112	.583	14.443	.000
Total Expenditure per ADM 08-09	-.001	.000	-.066	-2.328	.020
Average Daily Membership 2009	6.71E-005	.000	.019	.717	.474

a Dependent Variable: Average 2009 SAT Math

Average SAT Verbal 2009 predicted by % F/R Lunch Eligible, % White, and % bachelors (exp non-sig)

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.842(a)	.708	.706	17.014

ANOVA(b)

	Sum of Squares	df	Mean Square	F	Sig.
Regression	343548.304	4	85887.076	296.713	.000(a)
Residual	141546.741	489	289.462		
Total	485095.045	493			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	404.087	8.795		45.944		.000
Percentage of student eligible for free or reduced lunch	-.564	.084	-.272	-6.737		.000
Percentage of students that are White	.765	.063	.405	12.059		.000
Percentage of local households with bachelors	1.311	.094	.523	14.011		.000
Average Daily Membership 2009	3.96E-005	.000	.012	.468		.640

a Dependent Variable: Average 2009 SAT Verbal

Regression Model Summaries

Looking across all of the models, we found many similarities over time between the different PSSA tests. All of the SAT models are very similar as well. However, PSSA and SAT models are somewhat different. The differences include:

- The fit of the model tends to be higher with SAT as the achievement variable. R-squared was around .700 for the SAT models, while closer to .600 for PSSA tests. This indicates that the SAT scores are slightly better modeled by our education production formula.
- The fit within the PSSA models is not consistent, with PSSA science and PSSA reading having a slightly higher fit than PSSA math (.600 vs. .550).
- The fit of all of the models is superb for social science research.
- The effect sizes in the SAT models are larger than those in the PSSA models, however this make sense because SAT is measured on a different metric (average SAT score) than PSSA (percentage passing). SAT averages range from 300 to 800, in theory, and PSSA passage rates only range from 0 to 100.

There are similarities between all of the models with regards to the order of contribution in the models (here we look at Betas)

- In all of the models, % bachelors has the largest Beta. The second biggest contributor is % White. Both of these factor have positive regression coefficients. % eligible for free or reduced lunch contributes, overall, about half that of % White, and does so negatively. Expenditures is also negative, and smaller still than % eligible fore free or reduced lunch.

Looking across different types of achievement variables, and multiple years, we find that total expenditures per student in a school district to have a very minor effect on achievement. We used regression models so we could control for the effect of community and school factors (including district size). Earlier, when running correlations, we saw similar, negligible effects.

Summary Table 1: Regression Model Summary for District Level Percent Proficient/Advanced on the PSSA Math from 2007-2009 ¹						
	2007 PSSA Math %Pro/Adv		2008 PSSA Math %Pro/Adv		2009 PSSA Math %Pro/Adv	
	B ²	(β)	B	(β)	B	(B)
% F/R Lunch Eligible	-0.170	(-0.199)	-0.201	(-0.236)	-0.129	(-0.159)
% White	0.275	(0.351)	0.288	(0.369)	0.287	(0.387)
% Bachelor	0.561	(0.528)	0.470	(0.445)	0.536	(0.533)
PPE ³ (in \$)	-0.001	(-0.103)	n.s. ⁴	(n.s.)	-0.001	(-0.094)
R-Squared	0.554		0.538		0.541	

¹ Average Daily Membership (ADM) for the corresponding year was included in each model to control for the effect of district size

² Unstandardized and standardized (in parentheses) regression coefficients are presented

³ PPE stands for per pupil expenditure and is total expenditures divided by ADM

⁴ PPE was non-significant so it was removed from the model

Summary Table 2: Regression Model Summary for District Level Average Scores on SAT Math from 2007-2009 ¹						
	2007 SAT Math Average		2008 SAT Math Average		2009 SAT Math Average	
	B ²	(β)	B	(β)	B	(B)
% F/R Lunch Eligible	-0.623	(-0.286)	-0.576	(-0.257)	-0.528	(-0.231)
% White	0.740	(0.375)	0.824	(0.404)	0.859	(0.412)
% Bachelor	1.443	(0.538)	1.514	(0.547)	1.614	(0.583)
PPE ³ (in \$)	-0.001	(-0.090)	-0.001	(-0.052)	-0.001	(-0.066)
R-Squared	0.715		0.712		0.714	

¹ Average Daily Membership (ADM) for the corresponding year was included in each model to control for the effect of district size

² Unstandardized and standardized (in parentheses) regression coefficients are presented

³ PPE stands for per pupil expenditure and is total expenditures divided by ADM

Summary Table 3: Regression Model Summary for District Level Percent Proficient/Advanced on the PSSA Reading from 2007-2009 ¹						
	2007 PSSA Reading %Pro/Adv		2008 PSSA Reading %Pro/Adv		2009 PSSA Reading %Pro/Adv	
	B ²	(β)	B	(β)	B	(B)
% F/R Lunch Eligible	-0.157	(-0.212)	-0.165	(-0.216)	-0.182	(-0.240)
% White	0.286	(0.423)	0.323	(0.462)	0.277	(0.400)
% Bachelor	0.423	(0.461)	0.439	(0.463)	0.468	(0.498)
PPE ³ (in \$)	0.0001	(-0.084)	0.0001	(-0.056)	0.0001	(-0.094)
R-Squared	0.570		0.613		0.626	

¹ Average Daily Membership (ADM) for the corresponding year was included in each model to control for the effect of district size

² Unstandardized and standardized (in parentheses) regression coefficients are presented

³ PPE stands for per pupil expenditure and is total expenditures divided by ADM

Summary Table 4: Regression Model Summary for District Level Average Scores on SAT Verbal from 2007-2009 ¹						
	2007 SAT Verbal Average		2008 SAT Verbal Average		2009 SAT Verbal Average	
	B ²	(β)	B	(β)	B	(B)
% F/R Lunch Eligible	-0.601	(-0.304)	-0.607	(-0.301)	-0.564	(-0.272)
% White	0.624	(0.348)	0.652	(0.355)	0.765	(0.405)
% Bachelor	1.268	(0.520)	1.267	(0.509)	1.311	(0.523)
PPE ³ (in \$)	-0.001	(-0.072)	-0.001	(-0.060)	n.s. ⁴	(n.s.)
R-Squared	0.703		0.689		0.708	

¹ Average Daily Membership (ADM) for the corresponding year was included in each model to control for the effect of district size

² Unstandardized and standardized (in parentheses) regression coefficients are presented

³ PPE stands for per pupil expenditure and is total expenditures divided by ADM

⁴ PPE was non-significant so it was removed from the model

Summary Table 5: Regression Model Summary for District Level Percent Proficient/Advanced on the PSSA Science from 2008-2009 ¹				
	2008 PSSA Science %Pro/Adv		2009 PSSA Science %Pro/Adv	
	B ²	(β)	B	(B)
% F/R Lunch Eligible	-0.177	(-0.211)	-0.147	(-0.171)
% White	0.318	(0.415)	0.328	(0.418)
% Bachelor	0.497	(0.479)	0.605	(0.568)
PPE ³ (in \$)	n.s. ⁴	(n.s.)	-0.001	(-0.103)
R-Squared	0.583		0.622	

¹ Average Daily Membership (ADM) for the corresponding year was included in each model to control for the effect of district size

² Unstandardized are standardized (in parentheses) regression coefficients are presented

³ PPE stands for per pupil expenditure and is total expenditures divided by ADM

⁴ PPE was non-significant so it was removed from the model

Appendix 7: Changes from 2007 – 2009

In this final appendix, we explore correlations between changes in all of the input and outcome variables. The first two tables below show the correlations between changes in achievement scores from 2007 to 2009. Changes in SAT Math and Verbal scores are completely unrelated to changes in PSSA Math and Reading scores (whether measuring percent advanced, proficient or below Basic). On the other hand, changes in pro/adv, adv, and below basic are all fairly strongly related. This is expected because these rates are all conditional on each other. The percent advanced is part of the proficient and advanced rate, and the below basic rate is inversely related to it.

Change in SAT Math and Change in Math PSSA Correlations

Pearson Correlation	Change in SAT math	Change in % pro/adv on PSSA math	Change in % adv on PSSA math	Change in %BEBA on PSSA math
Change in SAT math	1			
Change in % pro/adv on PSSA math	.014	1		
Change in % adv on PSSA math	.081	.622(**)	1	
Change in %BEBA on PSSA math	.055	-.741(**)	-.414(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

Change in SAT Verbal and Change in Reading PSSA Correlations

Pearson Correlation	Change in SAT verbal	Change in % pro/adv on PSSA reading	Change in % adv on PSSA reading	Change in % BEBA on PSSA reading
Change in SAT verbal	1			
Change in % pro/adv on PSSA reading	.003	1		
Change in % adv on PSSA reading	-.016	.682(**)	1	
Change in % Below Basic on PSSA reading	-.002	-.744(**)	-.452(**)	1

** Correlation is significant at the 0.01 level (2-tailed).

The next table describes the relationship between the two expenditure measures, as they changed from 2007 to 2009. The correlation between the two expenditure measures, as they changed from 2007 to 2009, is 0.348, indicating they have a moderate relationship with each other. A relationship of some sort would be expected since instructional expenditures are a subset of total expenditures. In a statistical sense, since instructional expenditures are a subset of total expenditures, the correlation coefficient overestimates their relationship. It is probable that the two are only weakly related. We then ran correlations with the school and community factors to see if changes in expenditures are related to any of them. The only relationship we found is a

weak *negative* one between changes in instructional expenditures and the percentage of White students ($r = -0.277$).

Demographic variables and Change in financial markers Correlations

Pearson Correlation	Percentage of students that are White	Percentage eligible for free or reduced lunch	Percentage of households with bachelors degree	Total Expenditure Change
Total Expenditure Change	-.085	-.008	.030	1
Instructional Exp Change	-.277(**)	.091(*)	.088	.348(**)

We ran correlations with the school and community factors from the previous work to see if changes in expenditures were related to any of them. The only relationship we found was a weak negative one between change in instructional expenditures and the percentage of students in a district that are White.

Change of financial markers and Change in SAT math scores and PSSA math % Correlations

Pearson Correlation	Total Expenditure Change	Instructional Exp Change
Change is SAT math	-.045	.016
Change in % pro/adv on PSSA math	.052	.132(**)
Change in % adv on PSSA math	.056	.125(**)
Change in %BEBA on PSSA math	-.032	-.164(**)

Change in financial markers and change in SAT verbal scores and PSSA reading % Correlations

Pearson Correlation	Total Expenditure Change	Instructional Exp Change
Change in SAT verbal	-.020	.069
Change in % pro/adv on PSSA reading	.025	.113(*)
Change in % adv on PSSA reading	.025	.142(**)
Change in % Below Basic on PSSA reading	-.022	-.110(*)

Based on the regressions above, we ran regression models to see the possible effect the change of Instruction Expenditures from 2007 to 2009 had on PSSA math and reading scores and SAT math and verbal scores over the same time period. Neither of the SAT regressions were significant, so they are not included here. While the two PSSA regressions are statistically significant, there is little practical significance, as described in the report above.

2007 – 2009 % Change in Pro/Adv Math PSSA predicted by Change in Instructional Expenditures

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.132	.018	.016	8.46004

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	633.525	1	633.525	8.852	.003
Residual	35499.881	496	71.572		
Total	36133.406	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	.716	.691		1.037		.300
DIFFInsExp07_09	.003	.001	.132	2.975		.003

a Dependent Variable: DIFFpssamPA07_09

2007 – 2009 % Change in Pro/Adv Reading PSSA predicted by Change in Instructional Expenditures

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.113(a)	.013	.011	8.76414

ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	488.571	1	488.571	6.361	.012(a)
Residual	38097.816	496	76.810		
Total	38586.387	497			

Coefficients(a)

	Unstandardized Coefficients		Standardized Coefficients	t		Sig.
	B	Std. Error	Beta	B	Std. Error	
(Constant)	-12.242	.716		-17.105		.000
DIFFInsExp07_09	.002	.001	.113	2.522		.012

a. Dependent Variable: DIFFpssarPA07_09



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