Can You Buy Better Schools?

An Analysis of Pennsylvania Public School Funding and Student Performance

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Abstract

Public school funding is a hot-button issue currently, and has far-reaching ramifications within American society. The question on the table is whether or not the funding that school districts use is directly proportional to the student achievement results that they receive. I hypothesize that higher amounts of funding directed towards each student will result in better performance on standardized testing and in post-high school success. The method I employ is a series of OLS regression tests which analyze the connection between several Y-variables each serving as a proxy for student performance, and several independent variables consisting of per-pupil spending, average teacher salary, and poverty concentration. Each of the variables is the aggregate average of the school results from their district, and in total I have used results from 499 school districts in Pennsylvania. I find that there is a noticeable connection between these results and student performance, but the strongest is the district poverty concentration. The results indicate that the quality of home life is the variable that most influences student performance, over anything that a district can allocate funds towards.

Introduction

The importance and necessity of a strong and well-funded public school system in any modern society cannot be overstated. Public schools are the institution primarily responsible for educating the people that lead and support every single industry and facet of American life. The doctor you go to see, the person who made your car, and the person who is in charge of making sure the food you eat is safe most likely went through public school at some point in their life. There is no denying that a well-educated population benefits society and the lives of all people living in it; whether or not public school funding and policy has a direct and obviously apparent effect on you, it does affect your life.

The topic of focus in this research paper is that of public schools, their funding, and the performance of the students in these schools. Nothing in life is free, and that includes the basic necessary education of millions of people across the country. In recent times, it has become scary to look at funding levels by Congress and the implications of what they find to be most important. Unfortunately, education has not been one of those sectors that politicians have chosen to allocate increasing monetary importance towards. The question here is whether the funding and budget available to school districts has a significant impact on the ability of the student body to learn and perform well academically, and in life after school. Is there a strong effect on student achievement when the amount of money available to public schools is involved?

The hypothesis put forth is that the better funded and well-equipped public school districts are, the better they will be able to serve the student body, and student performance will rise. It is reasonable to believe that when schools have larger budgets at their disposal, they will be able to increase the achievement levels of their student body. More funds allow schools to

afford and allocate for more and oftentimes better resources, which properly equips them to help students in several notable ways, which later sections of this paper explain. There are several monetary-dependent inputs that should theoretically have a strong effect on the ability for students to effectively learn and master the material that their curriculum expects them to know by the end of the year.

This topic has potentially national implications, but this exact paper has strongly regional implications in terms of the data collected and the economic analysis performed. All districts studied were from the state of Pennsylvania, and all other data points were likewise Pennsylvania-exclusive. The exact nature of this study and the results it gives are specifically true only to the state of Pennsylvania, but the results could also signify national trends, given further testing on a wider scale.

This paper introduces the reader to the topic and what economists and researchers have studied already, before describing what this paper does. And how it builds upon the past body of work. First, there is a comprehensive review of the currently existing literature, covering both what previous researchers have found and what is lacking. This paper sets out to analyze certain elements that researchers have not fully addressed in past papers. Then the contribution section will outline the model and analysis used here to fill in what past research has not already explained. From the contribution section, this paper will propose conclusions that explain what has been determined from the data and analysis. After this, the paper will contain the tables which show the process and exact results of the analysis, and a sample of the data appendix used, along with a list of the academic and scholarly references cited throughout the paper.

Literature Review

The currently existing literature paints a fairly conclusive picture of how the economics field believes that money and funding affects public schools and the performance of their students. As far as the current field is concerned, school funding has a noticeable, statistically significant, and positive relationship to the success of public school students both in school and after they have graduated. I have yet to find a study that fully covers Pennsylvania school districts like this paper aims to study, but several state-level and national studies with similar techniques and forms of analysis have been conducted which confirm this trend.

Jackson, Johnson, and Persico (2015) discuss in their paper not only the exact level of improvement that they have found, but also the reasoning behind why student achievement increases with more funds. According to their research, when spending is increased by 10 percent, graduates of public school can expect to have a 7.25 increase in wages; this leads to a benefit-cost ratio (the calculated proportion between the amount of expenditures to the amount of positive change) of 2.01 (Jackson, Johnson, and Persico 2015, 40). The researchers narrow down the mechanisms responsible for increases in student performance to describe what types of spending are most helpful to students. The same 10 percent increase in funding as described above yields a 5.3 percent reduction in the ratio of students to teachers. It also increases the base teacher salary by 2 percent and leads to, on average, 1.14 more days of schooling in each year (Jackson, Johnson, and Persico 2015, 38). The authors write that other mechanisms may contribute to student success, but these differences point to a wise use of funds in improving the quality of schooling for students, and thus better results. One element to consider is that this study, however helpful it is, only examines post-schooling results and does not provide helpful

data on student achievement within the school program. Other research discussed in this literature review will cover this aspect of student performance.

Flaherty (2013) looks to the state of Pennsylvania and the student performance on standardized test results from the Pennsylvania System of School Assessment (commonly shortened as PSSA) through several years and grade levels across multiple districts to reach his conclusion. He found that there is a significant level of improvement over time for schools that increased in funding, with an especially pronounced level of improvement for the students in this study that originally took the test as 5th graders and then as 8th graders (Flaherty 2013, 147-148). To be precise, he found that with a 10 percent increase to the rate of growth in school spending there is approximately a 3-3.5 percent increase in PSSA passing rate growth (Flaherty 2013, 152). The model he constructs intends to find the empirical linkage between amount of money spent on education and the resultant test scores of that school district. He performs analysis across several districts and academic years to find if there is any significant connection between changes in funding and changes in performance. The set up and methodology of research in this paper is structurally similar to how I will conduct my research, only with a different measure of student achievement.

Klick (2000) has also examined how much tax revenue and funding have an effect on student performance in relation to their aptitude on standardized tests. He created a weighted model based on PSSA scores through different school years and grade levels to assess the success of students in the Pennsylvania school districts he researched. Klick constructed numerous different functional models, each of which he analyzed separately, but had similar assumptions of the connection between their respective variables used and achievement. From his research, Klick concluded that from 63 functional forms of the model, 22 showed

insignificant linkage, and out of the 41 that showed a significant impact on performance, 16 showed a negative impact. In the latter cases, increased funding showed a decrease in test scores. His findings indicate that increased funds have a small level of influence, and that there needs to be an increase of approximately a hundred thousand dollars for each pupil in order to bring the school's score up by .5 points, which he deems to be wildly impractical (Klick 2000, 84).

One factor in school funding and student performance that researchers discuss most frequently in the literature is exactly how important teachers are to the results. Most researchers assume and expect that higher teacher salaries lead to more highly skilled teachers, which in turn improves student learning and proficiency. The literature that I have found supports this assumption for the most part.

Tin-chun Lin (2009) addresses the first, the assumption that higher teacher salaries lead to better teachers. Lin has found that teacher quality and teacher salary endogenously correlate in the market, and after analysis, Lin finds a significant and positive relationship between the two (Lin 2009, 3). In addition to this, Lin discusses a supply-demand framework that questions whether a district would hire more qualified teachers based on this, and ultimately concludes that it is based on the goals of school authorities and whether they believe that teachers exert a sizeable enough influence on student proficiency (Lin 2009, 4). This research does not go into an exceptional amount of depth and only measures teacher skill with a formula that multiples their education level by their years teaching, but it provides a basic confirmation that further research can be based on.

In another paper, Lin (2010) discusses the effect that teacher salaries have on student achievement, building upon the previous research. Lin examines 500 school districts in

Pennsylvania over a time period of 3 school years to complete the case study. As a proxy for student achievement, Lin bases the research results on a formula that multiples SAT scores and the proportion of graduates from these schools that are in or have enrolled to 2-4 year post-secondary institutions with each other (Lin 2010, 547). Lin finds that both teacher quality and teacher salary exert a noticeable and positive influence on this measure of student success (Lin 2010, 549).

Past research examines other forms of compensation for teachers in addition to salary increases and the effects on student achievement that accompany them. Some school districts have implemented teacher and faculty incentive programs that reward them with various forms of compensation for when their schools meet certain criteria or hit specific benchmarks. In New York City, specifically, used over 200 schools in a trial run to test these incentive programs, and Fryer (2013) found that the results did not indicate success in the programs. The researchers used a composite of the environment the schools provide to their pupils, the academic performance of the students, and the academic progress of the students to measure schools for this study. The researchers applied this composite to each school that was involved in this study, and modified between elementary, middle, and high school levels of education to account for the differences in grading, testing, and measures of performance for each grade level (Fryer 2013, 381-382). The research concludes that any link between these programs and an increase in the above-listed metrics of school success are statistically insignificant in every subject area (Fryer 2013, 393). The main reasoning for this, the researcher believes, is that teachers are unaware of how to increase student performance, not unwilling, and no level of incentives towards their behavior can modify that reason (Fryer 2013, 404). The results support previously discussed findings that more qualified teachers are better suited to improve student learning, not the same

teachers with higher levels of incentives. Two important facts to note about this study is that it did not specify the exact nature of the incentives offered to teachers in these programs by the city-wide initiative, and that there is no uniformity in the incentives offered. All of the schools in the study offered incentive schemes that rewarded faculty for certain results, but the exact results and the rewards offered varied between each school.

One other form of spending that schools have employed in an attempt to increase student learning abilities is to direct funds towards the improvement of the physical school facilities. Researchers from the National Bureau of Economic Research have examined investments in public school facilities and infrastructure improvement and the effect that these investments have on student performance. The measure of student achievement used by the researchers of this paper includes scores from standardized tests, scores from high school exit exams, and overall school attendance (Martorell, Stange, and McFarlin 2015, 8). The study primarily looks at the state-level allocation of funds in Texas and finds no measureable or significant effect of facility improvement leading to an increase in student proficiency (Martorell, Stange, and McFarlin 2015, 16). The study concludes that funding of this type does increase the conditions of schools, especially older ones, and oftentimes alleviate overcrowding, but ultimately has more to do with local election promises and results than it does with actual student learning improvement (Martorell, Stange, and McFarlin 2015, 3).

Because much of public school funding draws from local property taxes, a significant level of importance in this area of research is on local government, property values, and taxpayer opinion. Tin-chun Lin and Shakil Quayes (2006) have examined the approximate effect of local taxes and tax revenue collection in relation to the expected performance of schools in the state of Pennsylvania. The researchers have created a model of school performance that uses teacher

salaries, racial and ethnic population proportions, student-teacher ratios, local taxes, and average income levels as independent variables against the dependent variable of average SAT scores to arrive at a quantifiable measure of school success (Lin and Quayes 2006, 424). After performing a regression analysis on the data they have collected, the researchers conclude that there is a statistically significant effect on school performance and level of success from local tax revenue (Lin and Quayes 2006, 425).

Stressing the importance of local taxes on education, there are numerous ways that outside factors can influence the revenue received from taxes. Property values, the distribution of tax revenue between different school districts, and enrollment in the public school system all play into the potential for school and student success in the public school system.

Researchers from the National Association of Home Builders and the University of Connecticut, School of Business and Department of Economics have examined how public school factors influence surrounding property values in the state of Connecticut, and subsequently, how this affects the tax revenue directed towards funding of public schools in the areas studied. The findings indicate that the test scores of schools in each district have mixed levels of influence on property value and desirability, but the population of Hispanic residents has a statistically significant and negative effect (Clapp, Nanda, and Ross 2007, 459-461). When they look at more recent years it appears as though the effect that Hispanic residents have is decreasing in magnitude. In addition to this, while test scores have a near zero effect in the entire spectrum of their sampled years, in the last seven year time frame they do have a statistically significant and positive interaction in a given district on the valuation of property (Clapp, Nanda, and Ross 2007, 462-463).

Similar research has been done to find what leads to parents enrolling their children in private school as opposed to public school, with ramifications relating to public school populations, demographics, student family median incomes, and perhaps most importantly, funding levels. Lin (2005) has found that because the enrollment rates of private schools do not appear to effect public school expenditures per pupil, the primary reasoning for parents to enroll their kids in private school may not be the quality of public schools. The most significant and positively linked factors appear to be the proportions of religious beliefs and proportional non-white populations (Lin 2005, 55). In these situations, parents are not choosing to enroll their kids in private school because of any low rates of expenditure on each student or assumed quality of the school, but the racial, ethnic, and religious construction of the student body and their families. In addition to this, median household income and income inequality link significantly to private school enrollment, which negatively affects the average level of income that the families of students enrolled in public school live with, and lowers the amount of potential revenue from local property taxes (Lin 2005, 56).

Due to the level of disparity in the public school system between districts, federal and state government has pushed for greater levels of equity in funding. Research by Douglas S. Reed (2001) finds that due to economic self-interest and aversion to taxation, people generally oppose equitable public school funding, despite general opinion favoring a reduction in financial barriers to education-related opportunities (Reed 2001, 35-38). Despite this, multiple reforms have pushed revenue collection and funding distribution to more equal dispersion in the public school system. Matthew P. Steinberg and Rand Quinn (2015) look specifically at Pennsylvania to find how much the legislative pushes have improved public school funding level equality and adequacy. They find that over the past two decades school funding has increased and has

become more equitably dispersed. Despite this improvement, however, districts that have a wider variety in their student body still struggle with spending disparities. Most of the improvement has focused on rural and disadvantaged districts, with less in larger and primarily suburban school districts, due to the increased diversity of income levels of student families in these districts (Steinberg and Quinn 2015, 294-296).

The primary deficiency in the current body of literature on this subject is the exact criteria used to determine student performance. In each of the papers I have listed above that measure student performance, the critique that I level against them is that they rely much too heavily on standardized test scores to determine the success of student achievement. Of the papers described above, the one that comes closest to analyzing the same criteria that this paper will outline is "Does Money Matter in Pennsylvania" by Sean Flaherty (2013). The primary difference between that paper and this one is that the model in this paper analyzes both independent and dependent variables that extend beyond that model proposed by Flaherty. These include the analysis and incorporation of Poverty Concentration as an independent variable, and a measure for post-public school success in the college admittance rates as dependent variables. The paper here looks at a portion of data that is not from directly within schools, in order to explain some of the outside factors on student performance. Poverty Concentration is an important variable to look at, because it has strong potential for influencing student lives and their subsequent performance. 2-4 year college attendance rates also provides a post-secondary-school measure of student achievement that Flaherty does not analyze in his paper, which reflects on aspects of student success not covered by standardized tests. In addition, this paper incorporates school district data of a more recent year, the data used below

from the 2011-2012 school year while Flaherty draws data only until the 2008-2009 school year, to update the results as much as possible within the publicly available data.

The aforementioned papers each interpret student performance slightly differently, but they all rely primarily on scores from either state-run standardized tests, or the SAT's. Faults in measuring student performance are present when basing it entirely or primarily on standardized tests, but the SAT's in particular are an opt-in test aimed at college-bound high school juniors and seniors. This test therefore does not factor in a large part of the student population at all, and heavily skews the results due to the proportion of students that are taking the test. It is for that reason that this paper relies upon PSSA testing for the necessary quantification of performance rather than the SAT's, and also performs regression analyses with 2-4 year college attendance as another metric that better represents post-secondary school success rather than just achievement on a standardized test.

Contribution Section

Introduction

Free public education for the American population inherently links to the funding necessary to provide it. Knowledge and training matter to the well-being of an operating free-market, and public education provides a way to ensure that everyone has a relatively even playing field when it comes to equipping people with the necessary requirements to participate in this system. There exists, however, a noticeable level of discrepancy in the necessary funding inputs and resultant success in student performance between each public school district.

Due to the variety of sources of funding for education, including local property taxes, state-level income taxes, and federal programs, there is disparity in the amount of funding for the specific needs of each district and the respective student bodies. The needs also vary greatly between each district, based on their location, size, and the backgrounds of and resources available to the members of the student body. Each district operates differently in order to theoretically best serve the needs of their student body, but not all are properly equipped to provide all that they need to.

The data collected and analysis performed within this report aims to determine the connection between available funding and per-pupil spending with student performance in the form of several different measures of academic achievement. The hypothesis of this research is that a higher amount of money allocated to each student has a positive effect on student performance on both standardized tests and on post-high school success.

Theoretical Section

The main theory of this paper and the connection between funding and achievement relies upon the notion that a higher amount of money available to institutions of public education

results in a higher quality education to the student body. The theoretical process as outlined through this paper measured the connection through student performance on state-wide standardized tests, the rates of student graduation, and attendance to post-secondary educational institutions.

The primary arguments behind the connection between funding and quality of education are that it allows school districts to hire more highly qualified teachers and that it equips each school with the necessary supplies to provide everything that their students need to effectively learn. Allocating a higher amount of money to teacher salaries allows school districts to hire teachers who can demand more money due to higher levels of training, education, and certification. Teachers have a sizeable impact on students because they are the primary educators and source of academic guidance, and thus their ability and qualifications may dictate most strongly the overall success of the school.

Economist Tin-Chun Lin has identified the connection between teachers and the performance of the schools that hire them. He displayed a strong and positive connection first between teacher salaries and teacher quality, showing in his analysis that higher salaries are the dominant factor in the performance of teachers in Pennsylvania public schools (Lin 2009, 3-4). He then followed up on this report with one that displayed the significant and positive relationship between teacher salaries in Pennsylvania public schools and student achievement (Lin 2010, 547-549).

The other argument posited is that in order for students to be able to learn they must first have the necessary facilities and resources such as classrooms that they are safe and comfortable in along with supplies such as textbooks and other learning tools. The amount of per-pupil spending in each district determines how much schools are able to spend on these student

resources. The amount of Actual Instructional Income per-pupil spending is a display of how much money districts spend specifically for each student's instruction.

The literature supports the connection because past research finds that increases in school funding have a stronger effect (potentially up 1.5 times stronger) on impoverished students (Flaherty 2013, 152). The strongest potential reason for this is that when a school is better able to supply resources that the student would not be able to afford otherwise, their performance strongly increases. Because students in poverty are affected much more than other students there is a clear indicator that resources that money can buy has an effect on their ability to learn and do well on tests. In addition to this, Jackson, Johnson, and Persico (2015) find that "compelling evidence that money does matter and that better school resources can meaningfully improve the long-run outcomes of recently educated children." They also state that it depends not just on the amount of money, but on how those funds are used, and specifically what resources districts spend towards (Jackson, Johnson, and Persico 2015, 4).

The reason that Poverty Concentration has been included as a variable is because the existing literature supports the notion that it has a significant effect on the results of students in school. As stated above, Flaherty (2013) found that there is a connection between the economic status of a student and their in-school performance, with their poverty level exerting a negative influence on their performance (Flaherty 2013, 152). In addition to this, Jonathan Klick (2000) provides an even stronger connection between the two. He finds that poverty was potentially the most significant determinant of the potential school success for students. As a specific example, schools that had a large concentration of low income students were most often unable to educate them in basic math or reading skills (Klick 2000, 85).

Data Section

The primary data sources for this research paper come from publicly available reports on Pennsylvania school district finances and performance supplied by the PA Department of Education website. The data collected is from the 500 school districts in the state of Pennsylvania during the 2011-2012 school year, as this is the most recent year available for PA Department of Education standardized test results. Data includes Total District Expenditures, Actual Instructional Expense (the amount of money that goes directly towards student education that is commonly abbreviated as AIE), Total District Enrollment, Average Teacher Salary in each district, Poverty Concentration (The percentage of the student body that is on free and reduced lunch programs), Adequate Yearly Progress (AYP) results, Pennsylvania System of School Assessment (PSSA) results, Total Graduates, and Post-Secondary Education Attendance.

Adequately Yearly Progress (commonly shorted to AYP) is a scoring system for public schools in Pennsylvania to ensure that they are complying with No Child Left Behind. It is a standardized measure of performance that is a compilation of three different metrics of school performance, which includes:

1. School Attendance (for schools such as the Elementary and Middle Schools in each district that do not have a graduating class) or
   Graduation Rates (for schools in the district with a graduating class)
2. The Performance of students on the PSSA test
3. The Participation rate of students in taking the test.

The AYP has several levels that a school can rank in when judged for their performance dependent on their success in these metrics. The goal for schools in each district in the first measure is to have either school attendance of 90% or improvement over the previous year if

there is no graduating class such as in elementary and middle schools. If the school has a graduating class such as in a high school, its goal is a graduation rate of 85% or a 10% reduction of the difference between the previous year's graduation rate and that rate. In terms of the Proficiency metric, a school district must have a minimum of 78% of all tested students achieve a score of Proficient or higher in mathematics and 81% or more receive a Proficient score or higher for reading. For the Participation metric, each measurable subgroup of students must have 95% of the student body take the test (Academic Achievement Report 2012).

The AYP is included in this data set as a qualitative measure of achievement along with the scores of students on standardized tests because it is a metric that includes multiple sources to create one composite ranking that has the potential to be more inclusive than a standardized test by itself, such as the PSSA. The AYP places schools and school districts into one of several different ranked categories based on their performance:

1. Made AYP (Best Category of Performance)
2. Making Progress
3. Warning
4. School Improvement 1
5. School Improvement 2
6. Corrective Action 1
7. Corrective Action 2

Because the data of AYP rankings is in the form of string rather than numerical data, their AYP scores are not analyzed in the same statistical way, but are rather looked at as a supporting trend for the other measures of success.

Model Section

This regression analysis consists of several separately constructed models, with each one representing a different measurement of achievement and performance, in order to account for the probability that any one measure would not and could not fully cover student performance. Each model uses a different dependent variable, but each relies on the same set of independent variables. The dependent variables each tested separately are the percentage of students falling into each rank on the PSSA in math and in reading and % College Bound. With each of those substituted in turn for Y, the model equation is:

$$Y_i=\beta_0+\beta_1 AIE_i+\beta_2 Sal_i-\beta_3 Pov_i+\varepsilon_i$$

The variables here being: Y_i for each dependent variable in its respective regression test, β_0 for the constant, β_1AIE for the Actual Instructional Expense Per-Pupil Spending, β_2Sal for Teacher Salary, β_3Pov for Poverty Concentration. The Theoretical Section outlines the reasons and support for the inclusion of each of these variables. All independent variables have a positive contribution with the exception of Poverty Concentration, because the model expects that students with lower socioeconomic backgrounds and potentially less stable families and home lives would not perform as well in school, so a higher percentage of financially struggling students would negatively impact the average test scores at a school.

To accompany this model, the estimation technique used is an ordinary least squares regression analysis of the model(s) in order to determine the connection between each independent variable and the dependent variable. The analysis of each model is a separate process, and then the analysis compares the results of each test to one another in order to

determine which Y values the independent variables effect. The analysis in the paper uses a model not based directly on any of the previously listed literature, but rather one created specifically for the study. The AIE Per-Pupil Spending is an independent variable in the model because it covers exactly how much money schools allot to the education and potential success of each student, which would include how much financial capital district administrators dedicate towards necessary resources for the students of the district. The District Average Teacher Salary is included because of the effect that teachers have on student learning and the previously mentioned literature's findings on the connections between teacher salary, teacher quality, and student achievement. The Poverty Concentration is included to account for the indirect, out of school lifestyle of each student, and the effects that would have on their ability to perform well academically. These data variables cover the possible factors affecting student performance in a relatively comprehensive range of different ways that money relates to the success of education based on school district.

Estimation and Summary of Results

The results of this study give some evidence in favor of the hypothesis, but analysis of the data indicates mixed results, as can be seen in more depth in the tables included at the end of the paper. The first indicator of potentially mixed results is the adjusted R^2 values that are present for each regression. The adjusted R^2 value, or the coefficient of determination, is the statistical fit of data analyzed by a model. A higher adjusted R^2 score indicates a better fit of the regression line to the data, and stronger support for the hypothesis as outlined by the model.

In the Math PSSA scores, the tests that resulted in adjusted R^2 scores closest to an acceptable value were for the percent of students in the ranges of Advanced, Basic, and Below Basic with adjusted R^2 scores (rounded to the second decimal place) of 0.57, 0.52, and 0.54

respectively. With cross-sectional data, an adjusted R^2 score of at least 0.60 is the expected goal out of any OLS regression. This means that the model used may be missing an independent variable and is not fully encompassing of all the factors that affect these test scores. These above listed scores are, however, close to the acceptable range, and do achieve a respectable adjusted R^2 score, despite not being quite as optimal as would be preferred. The one that stands out is the Proficient range, which has a low adjusted R^2 score of 0.28, meaning that these variables do not seem to approach any level of covering all factors that would control the resultant score. This means there must be some other variables that affect those students primarily in the Proficient range that do not affect students either below or above that score.

For the reading PSSA scores of Advanced, Proficient, Basic, and Below Basic the adjusted R^2 scores were 0.70, 0.18, 0.65, and .64 respectively. Again, with the exception of the Proficient score category, the other categories analyzed have relatively high adjusted R^2 scores, in this case being above the expected goal. The implications here are similar in that there is a difference between what variables affect the performance of those students who fit into the Proficient range, and those that affect the ranges above or below this score. It appears as though more independent variables have an effect on Proficient students than either students who excel or struggle on these standardized tests. In addition to this, the model outlined here, and the variables used in it to account for influences on student performance, appears to have a stronger correlation with Reading scores than with Math scores. It appears that for some reason, the way public schools teach Reading as compared to Mathematics, at least for the purposes of standardized testing, results in money and funding having a more likely effect on the student achievement. Another model would need to analyze this trend in order to determine what, if any, reason there is for this phenomenon.

For the rate of students accepted to 2-4 year college programs, the adjusted R^2 score is at 0.40, which is below the expected goal for an adjusted R^2 score. This means that there must be other variables needed in order to build a stronger correlation between metrics of funding and metrics of student performance in this area.

When testing each variable to see if they affect the result, a P-value of .05 or less indicates statistical significance at the 5% level and asserts that the independent variable give does in fact have an effect on the dependent variable. In the tests performed on Math PSSA score percentages, the data indicates that for the Advanced score (Table #1) the only variable in the formula shown to effect performance is Poverty Concentration with a P-value of $4.72x10^{-77}$, in the Proficient category (Table #2) Average Teacher Salary and Poverty Concentration both have an effect on student performance with P-values of $1.66x10^{-5}$ and $3.47x10^{-17}$ respectively. In the range of students performing at a Basic level (Table #3), the only factor shown to have any influence is, again, Poverty Concentration with a P-value of $2.62x10^{-71}$. Interestingly enough, for the Below Basic Math scores (Table #4), all of the variables given, that is AIE Per-Pupil Spending, Average Teacher Salary, and Poverty Concentration, all had statistical significance in determining the correlation of those inputs to the scores of the students; the P-values were, respectively, 0.02, 0.01, and $4.86x10^{-77}$. In Table #3 and Table #4 the expected signs for the Poverty Concentration variable of the model do not appear to match up with the signs achieved after testing, but could be explained by comparing and contrasting it with the higher score ranges in Table #1 and Table #2. As the poverty concentration rises so do the percentage of students in the range of Basic and Below Basic, logically supporting that they have not reached the levels of Proficient or Advanced as they otherwise would have.

For Reading scores in the Advanced range (Table #5), both Average Teacher Salary and Poverty Concentration had a statistically significant effect, with P-values at 0.01 and $4.05x10^{-105}$ respectively. As for Proficient reading scores (Table #6), the results are in strong contrast to previously stated ones; the independent variables that have statistical significance are AIE Per-Pupil Spending and Average Teacher Salary with P-values of 0.04 and $1.52x10^{-12}$ respectively. In the range of Basic reading (Table #7), Poverty Concentration is the only independent variable that has statistical significance with a P-value of $1.43x10^{-93}$. In the last category analyzed for PSSA scores, the Below Basic reading category (Table #8), all three independent variables have significance; AIE Per-Pupil Spending has a P-value of 0.03, Average Teacher Salary has a P-value of $2.79x10^{-4}$, and Poverty Concentration has a P-value of $6.04x10^{-103}$. The direction of the signs in Table # 7 and Table #8 are similar in results to the above described scenario in the Math tests. As poverty concentration rises, basic and below basic scores rise as well while advanced scores are negative. The logical conclusion is that the poverty concentration is negatively affecting district results, and leading to students that would normally score Proficient or Advanced dropping down to lower levels of performance.

As for college bound students (Table #9), Average Teacher Salary has significance with a P-value of $3.28x10^{-8}$ and Poverty Concentration has a P-value of $3.95x10^{-28}$. It would appear that the strongest indicator of school district student attendance to 2-4 year college programs is the Poverty Concentration of the student body for the district. Average Teacher Salary has a strongly significant and demonstrable effect, but not to the degree of Poverty Concentration, in this case. It does make sense with the data that the socioeconomic status of students in a school district has the strongest influence on whether or not they attend college, especially when one considers not just the academic requirements, but also the fiscal costs of college.

For all tests performed, the factor with the least effect on student performance was the AIE Per-Pupil Spending, in all cases except for three not reaching the necessary p-value for statistical significance. It appears that Poverty Concentration is the variable with the strongest effect on student performance, as it was present in the most instances of significance. The result is that the percentage of students in a school district that fall into the statistical metric of Poverty Concentration has a significant and negative effect on measured student performance. This shows that even though, in some cases, a higher average teacher salary and more money spent per student does help students learn and perform well, but the home life and financial security of a student has a stronger impact on their performance than any one factor that a school can allocate funding towards.

Conclusion

Based on the research performed, the main realization is that the matter of student performance is a more complex issue than how much money goes to schools. In some of the analysis performed above, the results show that more money available to the budget of a school has a significant and positive effect on student performance. Of the variables tested that apply to school budgets, the Average Teacher Salary amount displays more instances of having a statistically significant effect on student performance than the total amount of money spent per-student. This indicates that smart allocation of funds and budgetary direction towards hiring the most qualified of educators available would result in higher returns in student achievement.

The analysis also shows, however, a stronger connection between the percentage of students living within poverty and student body performance. The % Poverty Concentration variable has statistical significance in more instances than the other variables, and has a higher level of significance than the others. This indicates that paying teachers better and spending

more money per student does help improve performance in some cases, but the home life and financial security of a student has a stronger impact on their performance than any one factor that a school can allocate funding towards.

The results that the model above gives match up with previous ideas and results of past economic papers of similar topics, as discussed in the literature review. Most of the papers listed in the above literature review agreed that district spending has an effect on performance, but varied primarily in the level of influence. The previous research most similar to the results listed here is from the research of Klick (2000), in which analysis finds that there is a noticeable effect on performance, but it is not the most efficient way of boosting student achievement (Klick 2000, 84). Funding to schools helps improve the performance of students, but other outside factors have stronger influences than district budgets, and the amount of financial increase necessary to noticeably improve scores may be impractical. In addition, Lin (2010) found that teacher salary levels have a strong effect on student performance, out of the factors that school districts can control, which aligns strongly with the analytical results of the model used above, in which the average district teacher salary appeared as a statistically significant influence in most of the tests (Lin 2010, 549).

The research ultimately supports and upholds the original hypothesis, but points out other factors that future research should look into and explore in more depth. In the future, further testing could modify the above model to account for more variables in order to achieve higher adjusted R^2 score and to answer what else has a significant effect on student performance. Future analysis could also target other metrics of student performance and potentially account for more measures outside of the realm of standardized testing, in addition to college attendance rates. Further research into the effects of a district's poverty concentration on student

performance would shed some more light on how poverty affects students, and what remedies politicians can enact to best serve the public good.

Table and Data Section

Table 1: Dependent Variable= %Advanced Math PSSA Results

% Advanced Math								
Regression Statistics								
Multiple R	0.75511878							
R Square	0.570204373							
Adjusted R Square	0.567583667							
Standard Error	7.755423058							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	39259.48879	13086.49626	217.5767065	8.12289E-90			
Residual	492	29592.12071	60.1465868					
Total	495	68851.6095						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	69.2226582	3.201734352	21.62036278	2.28026E-73	62.93189902	75.51341739	62.93189902	75.51341739
AIE Per-Pupil Spending	-0.00014228	0.000179497	-0.792661949	0.428356855	-0.000494956	0.000210395	-0.000494956	0.000210395
Average Teacher Salary	5.40293E-06	5.11644E-05	0.105599408	0.915943233	-9.51248E-05	0.000105931	-9.51248E-05	0.000105931
Poverty Concentration	-54.18015085	2.420506067	-22.38381122	4.71585E-77	-58.93595477	-49.42434693	-58.93595477	-49.42434693

Table 2: Dependent Variable= %Proficient Math PSSA Results

% Proficient Math								
Regression Statistics								
Multiple R	0.537141497							
R Square	0.288520988							
Adjusted R Square	0.284182701							
Standard Error	3.5328532							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	2490.184948	830.0616493	66.50574544	4.0992E-36			
Residual	492	6140.677451	12.48105173					
Total	495	8630.862399						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	33.15646985	1.458496508	22.73332138	9.7073E-79	30.29081977	36.02211993	30.29081977	36.02211993
AIE Per-Pupil Spending	-7.4458E-05	8.17669E-05	-0.910612821	0.362945321	-0.000235113	8.61974E-05	-0.000235113	8.61974E-05
Average Teacher Salary	-0.00010138	2.33071E-05	-4.349740131	1.65791E-05	-0.000147174	-5.55861E-05	-0.000147174	-5.55861E-05
Poverty Concentration	9.645755822	1.102621036	8.748024489	3.46892E-17	7.479328927	11.81218272	7.479328927	11.81218272

Table 3: Dependent Variable= %Basic Math PSSA Results

% Basic Math								
Regression Statistics								
Multiple R	0.723545645							
R Square	0.523518301							
Adjusted R Square	0.520612925							
Standard Error	2.934382227							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	4654.618734	1551.539578	180.1895046	8.09504E-79			
Residual	492	4236.414734	8.610599053					
Total	495	8891.033468						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	3.513551637	1.211424871	2.900346295	0.00389432	1.133347254	5.89375602	1.133347254	5.89375602
AIE Per-Pupil Spending	2.52621E-05	6.79154E-05	0.371964738	0.710079254	-0.000108178	0.000158702	-0.000108178	0.000158702
Average Teacher Salary	3.18724E-05	1.93588E-05	1.646400086	0.100319987	-6.1638E-06	6.99086E-05	-6.1638E-06	6.99086E-05
Poverty Concentration	19.40946669	0.915835272	21.19318538	2.62196E-71	17.61003597	21.20889741	17.61003597	21.20889741

Table 4: Dependent Variable= %Below Basic Math PSSA Results

% Below Basic Math								
Regression Statistics								
Multiple R	0.733868967							
R Square	0.53856366							
Adjusted R Square	0.535750024							
Standard Error	3.593942454							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	7417.073667	2472.357889	191.4119731	3.06517E-82			
Residual	492	6354.879801	12.91642236					
Total	495	13771.95347						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-5.905586184	1.483716482	-3.980265945	7.92123E-05	-8.820788404	-2.990383964	-8.820788404	-2.990383964
AIE Per-Pupil Spending	0.000190855	8.31808E-05	2.294465898	0.022184043	2.74221E-05	0.000354289	2.74221E-05	0.000354289
Average Teacher Salary	6.4552E-05	2.37101E-05	2.72255163	0.00670798	1.79664E-05	0.000111138	1.79664E-05	0.000111138
Poverty Concentration	25.10449595	1.121687295	22.38101122	4.86489E-77	22.90060771	27.30838418	22.90060771	27.30838418

Table 5: Dependent Variable= %Advanced Reading PSSA Result

% Advanced Reading								
Regression Statistics								
Multiple R	0.836645718							
R Square	0.699976058							
Adjusted R Square	0.698146644							
Standard Error	5.98132272							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	41066.42014	13688.80671	382.6230425	3.5633E-128			
Residual	492	17601.90097	35.77622148					
Total	495	58668.32111						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	50.73679688	2.469318087	20.54688586	3.40989E-68	45.88508724	55.58850653	45.88508724	55.58850653
AIE Per-Pupil Spending	-9.45178E-05	0.000138436	-0.682754661	0.495083228	-0.000366517	0.000177481	-0.000366517	0.000177481
Average Teacher Salary	9.74062E-05	3.94603E-05	2.468464138	0.013908292	1.98748E-05	0.000174938	1.98748E-05	0.000174938
Poverty Concentration	-52.76303795	1.866800538	-28.2638862	4.0514E-105	-56.43092271	-49.09515319	-56.43092271	-49.09515319

Table 6: Dependent Variable= %Proficient Reading PSSA Result

% Proficient Reading								
Regression Statistics								
Multiple R	0.432784169							
R Square	0.187302137							
Adjusted R Square	0.182346662							
Standard Error	3.446527172							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	1346.921021	448.9736735	37.79701147	5.38498E-22			
Residual	492	5844.246379	11.87854955					
Total	495	7191.167399						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	49.24489203	1.422857833	34.6098471	6.3592E-134	46.44926472	52.04051934	46.44926472	52.04051934
AIE Per-Pupil Spending	-0.000163631	7.97689E-05	-2.051313086	0.040765408	-0.000320361	-6.90126E-06	-0.000320361	-6.90126E-06
Average Teacher Salary	-0.000165081	2.27376E-05	-7.260287738	1.51847E-12	-0.000209756	-0.000120407	-0.000209756	-0.000120407
Poverty Concentration	-0.774606403	1.075678254	-0.720109755	0.471799378	-2.888096192	1.338883385	-2.888096192	1.338883385

Table 7: Dependent Variable= %Basic Reading PSSA Result

% Basic Reading								
Regression Statistics								
Multiple R	0.808654626							
R Square	0.653922305							
Adjusted R Square	0.651812075							
Standard Error	2.380999815							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	5270.312496	1756.770832	309.8820276	6.2161E-113			
Residual	492	2789.226778	5.669160117					
Total	495	8059.539274						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	8.474623337	0.982967511	8.621468403	9.10769E-17	6.543291371	10.4059553	6.543291371	10.4059553
AIE Per-Pupil Spending	6.56871E-05	5.51076E-05	1.191979558	0.233843882	-4.25881E-05	0.000173962	-4.25881E-05	0.000173962
Average Teacher Salary	-2.77158E-05	1.5708E-05	-1.764433891	0.078279411	-5.85789E-05	3.14732E-06	-5.85789E-05	3.14732E-06
Poverty Concentration	19.18894104	0.743121872	25.8220647	1.42679E-93	17.72885715	20.64902493	17.72885715	20.64902493

Table 8: Dependent Variable= %Below Basic Reading PSSA Result

% Below Basic Reading								
Regression Statistics								
Multiple R	0.800855708							
R Square	0.641369865							
Adjusted R Square	0.639183096							
Standard Error	3.959024202							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	13791.23587	4597.078625	293.2956476	3.9422E-109			
Residual	492	7711.545335	15.67387263					
Total	495	21502.78121						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-8.484170455	1.634436148	-5.190885227	3.06743E-07	-11.69550628	-5.272834633	-11.69550628	-5.272834633
AIE Per-Pupil Spending	0.000193799	9.16305E-05	2.115008954	0.034931301	1.3764E-05	0.000373835	1.3764E-05	0.000373835
Average Teacher Salary	9.56126E-05	2.61187E-05	3.660700108	0.000278746	4.42947E-05	0.00014693	4.42947E-05	0.00014693
Poverty Concentration	34.35154602	1.235631123	27.80080995	6.0395E-103	31.92378125	36.77931078	31.92378125	36.77931078

Table 9: Dependent Variable= %2-4 Year College-Bound

% 2-4 Year College-Bound								
Regression Statistics								
Multiple R	0.634338039							
R Square	0.402384748							
Adjusted R Square	0.398740752							
Standard Error	0.115315566							
Observations	496							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	3	4.405151078	1.468383693	110.4240535	1.12703E-54			
Residual	492	6.542458404	0.01329768					
Total	495	10.94760948						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.550378618	0.047606662	11.56095785	1.63166E-27	0.456841174	0.643916063	0.456841174	0.643916063
AIE Per-Pupil Spending	2.50622E-07	2.66895E-06	0.093902959	0.925224471	-4.99332E-06	5.49456E-06	-4.99332E-06	5.49456E-06
Average Teacher Salary	4.27201E-06	7.60765E-07	5.615415727	3.28283E-08	2.77726E-06	5.76676E-06	2.77726E-06	5.76676E-06
Poverty Concentration	-0.421638786	0.035990561	-11.7152602	3.95054E-28	-0.492352945	-0.350924627	-0.492352945	-0.350924627

Data Appendix

The amount of data used for this analysis is too large to be included in this paper, email the researcher at zrcober@millersville.edu for the complete data set of the information analyzed.

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Data Sources

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http://paayp.emetric.net/

Pennsylvania Department of Education Portal: Data and Statistics:

http://www.portal.state.pa.us/portal/server.pt/community/data_and_statistics/7202