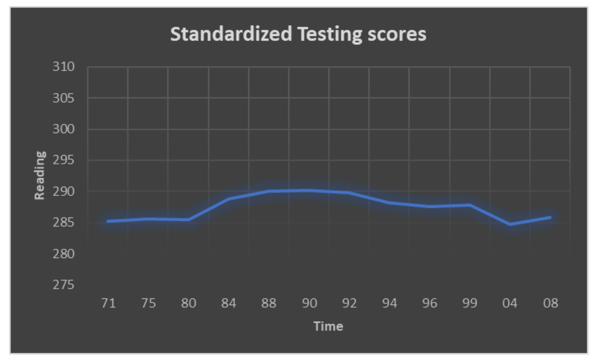
School District Expenditure Efficiency in Utah

Steven Dabb

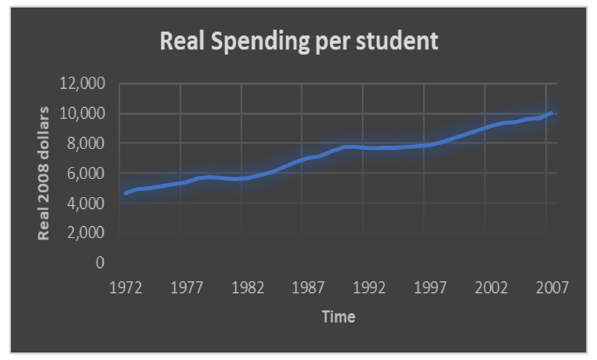
Abstract

Education is key to improving the human capital of a society. To increase the value of that education, one aspect that research can help develop is the analysis of the allocation of funding within school districts and other local educational agencies (LEAs). This paper explores the efficiency of Utah school districts and the effect of differing budgetary allocation on student proficiency on the Criterion Referenced Test in Utah between 2008-2013 and finds that a reallocation of salary expenditures to benefits expenditures would have a positive impact on increasing student success.

Background



Standardized test scores on the Long-Term Trend Reading assessment have not changed significantly between 1971-2008



Real spending per student has more than doubled between 1972 and 2007

Literature

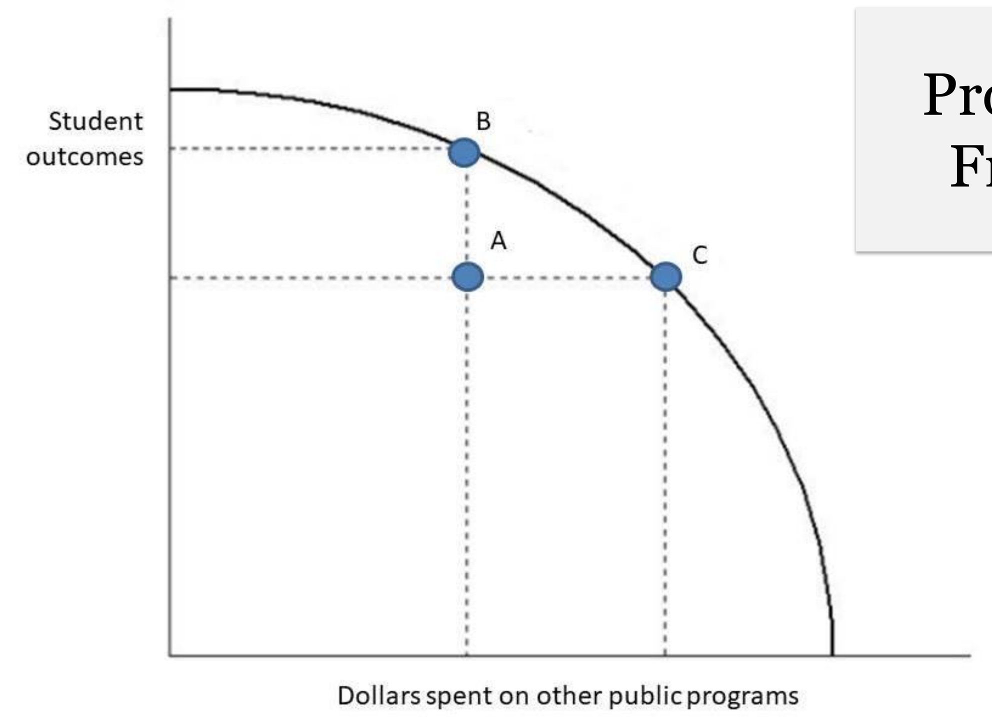
Production functions are typically applied to education, viewing school and student characteristics as inputs and student achievements as output (Hanushek, 2008)

Student performance is typically more dependent on socioeconomic factors, but better funding can serve to equalize across backgrounds (Coleman, 1966)

Utah school districts have been historically efficient, with the main indicator of student performance being parental education (Chakraborty, 2001)

Overall amount spent on schools matters less than the specific allocation of funds for those schools (Carter, 2014)

Theory



Production Possibilities Frontier of Education

Results

VARIABLES	(1) Avg. proficiency	(2) Math	(3) Science	(4) ELA
Total salary per student ($100s)	-0.0138**	-0.0071+	-0.0210**	-0.0133**
	(0.003)	(0.004)	(0.005)	(0.003)
Total salary per student ($100s) sq.	0.0001**	0.0001*	0.0001**	0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)
Total benefits per student ($100s)	0.0146**	0.0088	0.0187**	0.0162**
	(0.004)	(0.007)	(0.006)	(0.004)
Total benefits per student ($100s) sq.	-0.0002**	-0.0001	-0.0003*	-0.0003**
	(0.000)	(0.000)	(0.000)	(0.000)
Total supplies per student ($100s)	-0.0014	-0.0162*	0.0084	0.0037
	(0.004)	(0.007)	(0.005)	(0.003)
Total supplies per student ($100s) sq.	-0.0000	0.0002	-0.0002	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
Total property per student ($100s)	0.0000	-0.0001	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Total services per student ($100s)	-0.0002	-0.0004	-0.0002	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
Real Income per capita	0.0000	0.0000	-0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.9389**	0.7785**	1.0548**	0.9834**
	(0.066)	(0.125)	(0.075)	(0.061)
Observations	235	235	235	235
R-squared	0.3634	0.2773	0.3357	0.2167
Number of district_no	40	40	40	40
District FE	Yes	Yes	Yes	Yes

Empirics

- Data were retrieved from the Utah State Office of Education regarding district program expenditures and district performance on the Criterion Referenced Test
- Observations between 2008 and 2013 were used
- This analysis employs a fixed effects regression model

$$Y_{it} = \alpha + \beta X_{it} + P_i + €_{it}$$

- Where Y is student performance in school district *i* at time *t*, X is a vector of time varying factors (expenditures, local income), P is a school district specific error term of time-invariant factors, and € is a typical error term for school district *i* at time *t*

Conclusion

These results indicate that school district budget allocations in Utah are not currently efficient. The application of funding in Utah currently has differing effects depending on where it is applied: a negative coefficient on salaries and a positive coefficient on benefits indicates that inefficiency exists within compensation for employees of these school districts.

For example, if the average school district were to increase total benefits per student by one hundred dollars, the additional funds in the benefit category would lead to an increase in total average proficiency by 1.38 percentage points. However, rather than simply allocating additional funding, if that money were reallocated from salary, proficiency would improve by an additional 0.5 percentage points because of the negative relationship between salary and salary expenditures and proficiency.

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Education is key to improving the human capital of a society. To increase the value of that education, one aspect that research can help develop is the analysis of the allocation of funding within school districts and other local educational agencies (LEAs). This paper explores the efficiency of Utah school districts and the effect of differing budgetary allocation on student proficiency on the Criterion Referenced Test in Utah between 2008-2013 and finds that a reallocation of salary expenditures to benefits expenditures would have a positive impact on increasing student success.

Introduction

Key to a society's economic growth is improving human capital. One way to achieve this is through better educating the population. In the United States, some sort of schooling, most often public, is required. In order to improve education, one important tool policymakers can influence is funding and how efficiently that funding is allocated. This article explores the effect of differing budget allocations of school districts in Utah on student proficiency. In order to assess student proficiency, most school districts use state-legislated standardized tests. While policymakers are limited as to how much they can influence schools' success, identifying which areas of spending have the greatest impact on student achievement could make a difference as to how successful those schools are.

This research finds that school districts in Utah do allocate funds efficiently. It also examines which expenditure types within schools have the greatest benefit for student proficiency, and finds that, on average, the reallocation of $100 per student from salary expenditures to benefit expenditures results in an increase in total average proficiency on standardized tests of 1.58 percentage points. This paper also explores a potential method for policymakers or school district administrators to determine efficient allocations of funds.

Background

Education is crucial to economic and social growth. For a society to have long-term, stable economic growth, most models assume that there must be an improvement in human capital, and public education provides a path to that. This is particularly true in developed nations like the United States, where population growth rates are typically lower than developing nations. Without a skilled labor force innovating and improving, there are few avenues through which a society can achieve consistent long-term growth. As a result, the United States has focused heavily on the quality of public education. Some level of public education has been available in the U.S. for the last 200 years. Prior to this, if people were formally educated at all, they were taught at private institutions of varying quality and reputation. As long as there have been educational institutions, quality and retention rates have varied. Today, this continues, and has resulted in the need to empirically assess the quality of educational institutions and their impact on student learning retention.

Though standardized testing has become the norm for American children, formal examinations have long been used as a metric to gauge progress and intellectual achievement. The use of vocational, aptitude, and intelligence examinations has been widespread since the early 20th century. By 1926, colleges had begun to administer the SAT to determine students' college readiness (PBS, n.d.). Since then, standardized testing has become commonplace in schools, with 95% of four-year colleges using either the ACT or SAT exam in their admissions processes (Morse, 2008). Both the ACT and the SAT are designed to assess college readiness across multiple subjects. The SAT focuses on writing, reading, and mathematics. The ACT contains additional sections in science and English. While there is no mandate that requires students to take either of these exams, anyone seeking higher education typically takes at least one.

The No Child Left Behind Act (NCLB) of 2001 changed the face of education. Amid concerns about the rigor of the education system in the U.S., NCLB focused on increased accountability for students, teachers, and schools as a whole. NCLB set standards for Adequate Yearly Progress (AYP) in subjects of emphasis, such as math, reading, and writing. Schools that failed to meet AYP were subject to remediation (OSPI, 2011). This progress, as well as general school accountability for each subject, continues to be measured by yearly assessments students take at the end of each school year.

Spending in Education

Effective improvements in fiscal policy are the goal of both national and local legislatures. At least superficially, however, the quality of public education appears to be immune to these efforts. Between 1978 and 2008, per-pupil spending in the U.S. nearly doubled, while performance on the Long-Term Trend Assessment increased by an estimated 2% on mathematics, and no significant change occurred in reading scores on the same assessment (NAEP, n.d.; NCES, 2009). Such disparity between spending and improvement in standardized test scores can indicate undesirable underlying events. For example, it may be that public education is currently inefficient, with extra funding not being used effectively for a number of possible reasons. Perhaps funding is not reaching crucial areas -- areas where it would be put to the most good. It is plausible that the effect of an additional dollar spent in the education sector may have different results depending on its specified allocation: it takes little imagination to think that a dollar spent on a teacher may be more effective in influencing student outcomes than a dollar spent on property maintenance, or that a dollar spent on a textbook may be more beneficial than one spent on an administrative bonus. In a less attractive scenario, it may be that additional funding of public education is not being used to any academic benefit because there is simply no improvement to be made. If significant improvements to education cannot be made possible through additional funding, then perhaps government funding would be more effectively used in another sector instead of education. The additional funds could instead be reallocated, and student outcomes would remain unchanged.

Because of these possibilities, it is important to know how dollars spent in the education system affect the ultimate academic achievement of students. If school districts could determine which spending areas benefit students the most, they could have the option of allocating more of their resources to target those areas for academic improvements. Because not every school district or region is the same, perhaps key spending areas would not remain constant for every school district or region. Therefore, it is necessary to take a smaller sample -- a state, for instance -- to show which categories of spending are key to that state's academic progress. Since we are assuming that the path to growth is human capital, understanding how to improve that capital is essential to economic growth.

Chakraborty and Lewis (2001) studied the effect of individual school districts' technical efficiency for Utah, and estimated the effect differing levels of efficiency had on student testing outcomes. Ultimately, they found that levels of parental education are far more effective in determining student outcomes than an individual school district's efficiency measure.

Despite Chakraborty and Lewis' findings, it is beneficial for school districts to understand where their funds do the most good in regard to student academic success. Though parental education is a major factor in determining students' achievement, a school district's allocation of funds almost certainly also has some influence on student success. This article studies school district resource allocations, controlling for income to determine the key areas of school district spending as it pertains to improving students' learning.

Palardy and Nesbitt (2015) focused particularly on administrative expenses between public and charter schools and found that while statistically significant changes can occur from re-allocating funding within a school district, the economic significance of doing so is slight.

This article builds on Palardy and Nesbitt's research by identifying which areas, when given funding, are the most likely to improve student outcomes for the school district, thereby improving the output of human capital in the form of better-educated students. Because improved human capital will lead to a society's economic growth, the academic and economic success of a school district are related to each other. Therefore, it is beneficial to analyze school districts' financial expenditures to determine the most influential areas of allocation on student success.

Literature Review

The question of how financial allocation in public education affects student outcomes involves four major branches of literature: the production function of education, inefficiency in public schools, how funds are allocated in public schools, and what factors determine student performance.

Production Function of Education

Production functions show the possibilities of output given by varying combinations of inputs, with the frontier being the maximum possible level of output. Points beyond the frontier are unattainable, while points within the frontier are inefficient. Questions arise regarding the production function application in modern education. Monk (1989) pointed out that it may not have been possible to prove an education production function existed, and the concept had serious drawbacks: specification of production functions took various forms based on included factors, with no guarantee as to homogeneity or comparability of inputs or outputs. Regardless, several previous studies adapted production functions for application in education (Krueger 1999, Chakraborty 2001, Hanushek 2008, Hanushek 2010, Monk 1989, Filmer & Pritchett, 1998, Palardy et al 2015, Ray 1991).

In a meta-analysis by Hanushek (1986), most studies regarding specification of particular factors in determining student outcomes—including teacher-student ratio, teacher education, expenditure per pupil, etc.—yielded results of little statistical significance. In the few studies in which findings are statistically significant, the conclusions researchers drew have been wildly different. For instance, of 106 studies that analyzed teacher education, only 11 found a statistically significant impact, and of those, only six determined that teacher education played a positive role in student outcomes, while five determined that greater teacher education played a negative role in student outcomes.

In the same meta-analysis, Hanushek stated that while most studies found expenditures per pupil statistically insignificant, the majority of studies that did find expenditures per pupil significant also found a positive coefficient, as would be expected.

Hanushek (2008) discussed some of the complexities of applying production functions in education: student outcomes were dependent on different factors, some of which were directly controllable by policymakers (like funding) while others were completely uncontrollable (typically background characteristics).

Determinants of Student Performance

Educational outcomes, often measured by standardized test scores, could depend on a number of factors including socioeconomic status of students, demographics of the student body in question, and other environmental factors (Coleman et al, 1966, Murgo & Walsh, 1993). Chakraborty, et. al. (2001) calculated technical efficiency estimates for the 40 school districts in Utah from 1992-93 and found that while the most important factor in predicting student performance was the level of parental education, school districts could affect outcomes based on the demographics of the populations they served by focusing on controllable inputs in areas of high socioeconomic status, while focusing on raising levels of background education for areas of lower socioeconomic status.

Coleman, et. al. (1966), found that when controlling for socioeconomic factors, schools made a relatively small impact on student achievement. However, these differences in schools had a heterogeneous impact across different demographic groups, particularly affecting minorities. Students of more privileged backgrounds attending different schools would see little difference in academic success caused by the school itself, while minorities would be most impacted by the relative strength or weakness of their school.

Carver (1975) found that the Coleman (1966) study was biased against finding significant differences between schools. Instead, Coleman focused on the success of the individual students because of the metric of choice. Carver concluded that the differences between schools was much larger than Coleman (1966) suggested when taking only one year of comparable data from each school (rather than focusing on individual data).

To explain the difference in the above findings, consider the following example. If two students of the same socioeconomic background and educational level were each placed in a different school, their academic results at the end of a single year would be a far better indicator of the effectiveness of the school than data from students who were already a part of a school system for a significant period of time. This is an example of potential selection bias in Coleman's sample (Heckman, Tobias, & Vytlacil 2001).

Another significant determinant of student success was teacher competency, as discovered by Strauss and Sawyer (1986). They found that while improvements in teacher quality had a relatively negligible impact on general student performance on standardized tests (0.5-0.8% per 1%), it had a far larger impact in its reduction of students' rate of failure on standardized test scores (5% reduction in failure per 1% increase in teacher quality).

Inefficiency in Public Schools

Since public school spending nearly doubled between 1978 and 2009, with relatively little change in student outcomes on educational assessments, two major possibilities exist: it may be that funding had no role whatsoever on student outcomes and that educational spending should not be increased, or it may be that additional funds have been used inefficiently negating the benefit of increased spending. Many studies have examined inefficiency in public schools (Marlow 1997; Chakraborty, Biswas, & Lewis 2001; Palardy, Nesbit, & Adzima 2015)

Chakraborty (2001) also calculated the technical efficiency for each school district in Utah using stochastic and nonstochastic estimations and found that most school districts in Utah were technically efficient with a mean efficiency of 85.8%.

Bowen and Trivitt (2014) found that in Florida, the introduction, and later removal, of private school vouchers as an alternative for public schools failing to meet state academic standards did not affect the success outcomes of public schools. The threat of losing students and funding to private schools was ineffective as a driving factor for student success.

Allocation of Funding

Whether increasing funding actually had a legitimate impact on student success was a moot point, and researchers disagreed as to whether differing allocations of funding made any difference at all. In a statewide study in Kansas from 1997 to 2006, researchers found that educational reform in Kansas and the following increase in educational spending had little effect on student academic success (Neymotin 2010). However, in a Kansas statewide study from 2005 to 2014, researchers found that increasing the amount of money available to school districts greatly increased student performance on ACT, SAT, and NAEP tests. The allocation of the funding mattered significantly less than the overall increase in funding available to school districts to use how they saw fit (Grubb 2009, Hanushek 1989).

These changes in the same state could have been the result of increased technology or other differences in funds allocations that had a higher impact on student success than in the previous decade.

Carter (2014) determined that the overall amount spent in schools in California mattered less than the specific allocations of funds. Though school districts that received more money did not proportionally perform better, Carter suggested that this was because the funding was not being placed in the most effective categories. Research suggested that while spending did help to an extent, it was more important to focus on areas in which educational methods could be improved, such as professional development and other pedagogical spending areas (Carter 2014).

These two differing viewpoints suggested that there was a balance for school districts to strike—the overall amount of funding was important, but at some point, increasing the dollar amounts going to school districts was less effective than targeted spending of those same resources.

Theory

When examining the economics of education, researchers typically use a production function (Chakraborty, Biswas, & Lewis, 1999 & 2001; Hanushek 2010; Krueger 1999; Monk 1989). At its basic level, a production function examines the transformation of inputs into outputs. With regards to education, the examined output is typically student outcomes, while inputs can be broken down into two major categories: non-school characteristics and school characteristics.

While this paper used standardized testing performance as a measurement of student outcomes, other potential measures included graduation rates, college acceptance rates, or lifetime earnings. Though there may have been concerns as to whether standardized test scores were the best measure of student success, researchers often use standardized testing scores for ease of use and availability of data. (Card and Payne 1998; Chakraborty, Biswas, & Lewis 2001; Murgo and Walsh 1993).

The first major distinction of inputs, non-school characteristics, include demographics of individual students, socioeconomic status of the geographic area in question, and individual potential. Chakraborty, et. al. (2001) found that the most important factor for predicting student outcomes was the level of parental education. These findings indicated that while non-school characteristics were not the focus of this paper, they certainly played a role in student success.

The second major distinction of inputs, school characteristics, can be affected by public policy. These characteristics include teacher-student ratios, dollars per student, teacher quality, and allocation of budgetary expenditures. The combination of these gives a function:

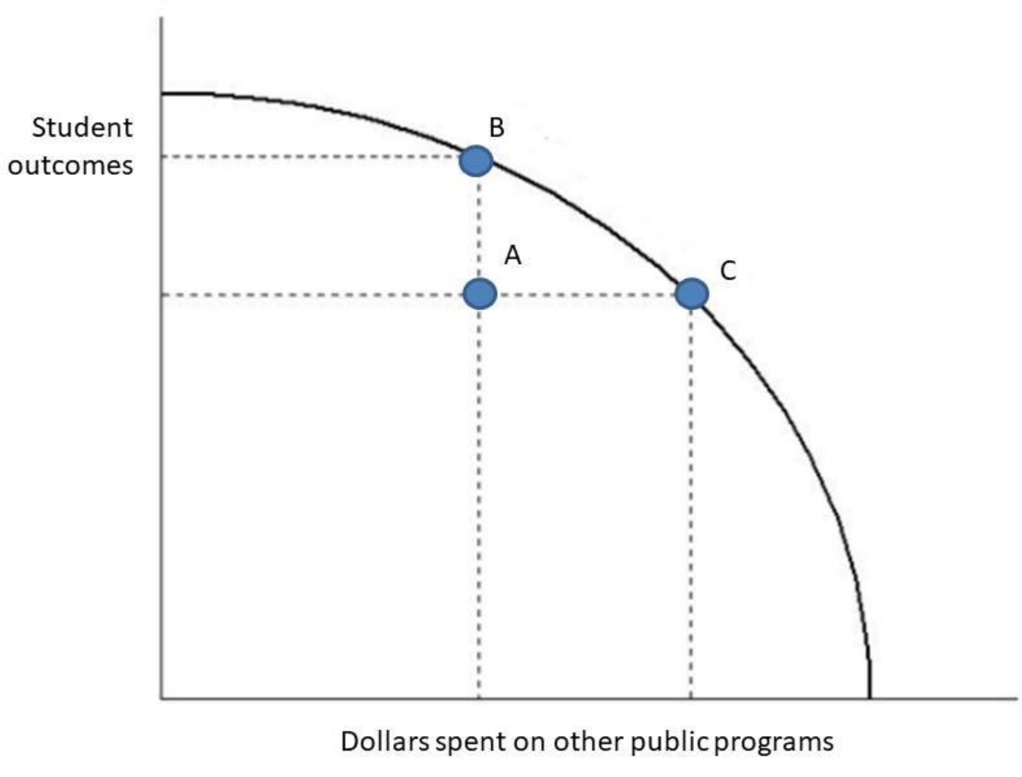
$$Y = f(N, S) \tag{1}$$

where Y is student outcomes measured via standardized test scores,

$N = (N_1, N_2, \ldots N_n)$ is a vector of non-school characteristics including education, population, poverty measures, home ownership, and income of the local geographic area, and

$S = (S_1, S_2, \ldots S_n)$ is a vector of school district characteristics, particularly expenditures distributed among administrative, salary, benefits, supplies, property, and other expenditures.

Between 1978 and 2008, per-pupil spending in the U.S. nearly doubled, while performance on the Long-Term Trend Assessment increased by an estimated 2% in mathematics, while no significant change occurred in reading scores on the same assessment (NAEP, 2018; NCES, 2009). This leads to two major theories, which can be shown using a production possibilities frontier.



A common assumption is that public schools must be inefficient -- after all, they have received more funding with little change in student outcomes. Any point along the production possibilities frontier is efficient, so the assumption is that public schools typically lie within the frontier. The two goods in this situation for those creating public policy would be student outcomes and dollars that could be spent on other public programs.

If schools are efficient, then by taking the first-order condition of equation 1 with respect to school expenditures (salaries, benefits, supplies, property expenditures, and service expenditures) we arrive at

$$(2) \qquad \frac{\partial Y}{\partial_{sal}} = \frac{\partial Y}{\partial_{ben}} = \frac{\partial Y}{\partial_{supp}} = \frac{\partial Y}{\partial_{prop}} = \frac{\partial Y}{\partial_{serv}}$$

as our efficiency condition, where the marginal effect on student outcomes of each expenditure type are the same. Intuitively, this would imply that an additional dollar spent would have the same impact no matter where it was applied. However, if when taking the first-order condition we find that equation 2 is not true (i.e., that the marginal effect of on expenditure type is different than another), then budget allocations are not efficient, as the marginal effect of a dollar is different depending on where it is applied. If this is the case a reallocation of funding between expenditure types would improve outcomes while keeping the same level of overall expenditures.

Assuming that schools are currently inefficient, most public schools exist inside the frontier denoted by point A. If we assume that schools still have room to improve, then by more effectively utilizing funding, schools will be able to rise to point B on the production possibilities frontier, improving student outcomes while maintaining the same amount of funds available for other public programs and arriving at an efficient outcome.

If equation 2 is shown to be the case, then differing allocations show no evidence of improving student outcome and efficiency can be obtained by reducing education spending and thus allocating more funds to other public programs. This would be shown as a transition from point A to point C, maintaining the same level of student outcomes while increasing dollars available to other public programs.

Empirics

Data for this analysis were primarily collected from the Utah State Board of Education.

Financial data

First, data were retrieved regarding financial expenditures from the Superintendent's Annual Report, a report issued each year containing information regarding revenues and expenditures for public school districts and charter schools in the state, as well as enrollment levels, dropout rates, and other information. Data regarding revenues and expenditures for 40 public school districts from 2008 to 2013 were collected. Revenues were divided into three categories: state, federal, and local.

Expenditures were divided among salaries, benefits, services, supplies, property, and a miscellaneous expense category. Salary included payment to permanent and temporary employees of any Local Educational Agency (LEA), including full-time, part-time, and substitute teachers as well as administrators, office personnel, etc. Benefits included state retirement fund contributions paid by the employer, Social Security, and local retirement plan contributions. Also included in benefits were group, industrial, and unemployment insurance as well as any fringe benefits. Services included employee training development services, professional services, and administrative services. Excluded were services purchased from another LEA. Utilities, maintenance, legal service, etc. also fit in this category. Supplies were items that were consumable in nature, including fuel, electricity, food, textbooks, software, etc. Property includes expenditures regarding land and site improvements, depreciable equipment, buildings, intangible assets, and depreciation/amortization.

Financial data were also divided according to program, with programs being general education, special education, applied technology, special population, block grants, etc. Focus was given to general education, special education, and applied technology as allocations were most consistently given through these programs. General education funds typically included standard education programs and subjects as well as sports. Special education included self-contained units, severe behavioral programs, programs for the severely disabled, and intensive services. Applied technology programs referred to agricultural, health science, business, family and consumer science, and technology and engineering programs.

Student performance

Data regarding student performance were retrieved from published data reports by the Utah State Board of Education. Data included percent proficient in each of three subjects: math, English/language arts (ELA), and science. Data used for this analysis was overall percent proficient in each of the three subjects for each of the 40 LEAs in question. This dataset was the overall limiting dataset, as the standardized test in question, the Criterion Referenced Test (CRT), did not have any published proficiencies before 2008. The CRT was officially replaced beginning in 2014 by the Student Assessment of Growth and Excellence (SAGE) test. While SAGE test outcomes were also reported in percent proficiencies, no definitive work had been done regarding direct comparisons between the two assessments.

Panel dataset

The final dataset used for this analysis includes financial revenues and expenditures, percent proficient on standardized assessments, enrollment, and income data based on the county each LEA was based in. All monetary terms were deflated to 2009 dollars using CPI for all urban items. Income and CPI data were retrieved from the Federal Reserve Bank of St. Louis (FRED). Data spans six years, from 2008 to 2013 for 40 public school districts in the state of Utah. Any observation that did not have financial or standardized assessment measures was dropped from the data set, resulting in 235 usable observations.

Summary statistics

Expenditures for each school district in Utah were broken down by program and expenditure type. For example, general program benefits referred to expenditures on general programs (like typical curriculum, sports, etc.) in the benefits type. Insurance plans for coaches and retirement contributions for teachers were two examples of what would fit in this category.

For the data set, all yearly income data was adjusted to reflect the real income, so as to compare income and test scores in a way that would allow for accurate comparison across the entire data set (between 2008 and 2013). In terms of real income per capita for each school district, San Juan School District in 2008 had the lowest real income for the entire data set, while Park City School District in 2013 had the highest real income per capita. For the entire data set, Ogden School District had the lowest proficiency in math in 2010, while Piute School District had the highest in 2013. For percent proficient in science, Ogden School District again had the lowest achievement of the data set, this time in 2008, while Morgan School District had the highest in 2012. For percent proficient in ELA, Ogden School District again had the lowest performance in 2008, while Daggett School District had the highest achievement of the data set, in 2013.

Methods

Because of the panel nature of this dataset, as well as a high likelihood of systemic differences between individual school districts, a fixed-effects model was employed. Each individual school district was likely to face individual time-invariant attributes that were unobservable, or data regarding them was unavailable. An example of the former was culture--potentially a general attitude towards education that simply could not be effectively measured. Some school districts contain primarily rural areas where attitudes towards education may have been different from school districts located in a university town. These attributes were unlikely to have changed during the timespan of this analysis, making fixed-effects an effective approach. A specific example of lack of data was the level of education of the region in which the school district was located. While a useful control measure, data regarding area education levels was unavailable. However, it was also unlikely that the educational composition of the region changed drastically during the sample period, allowing for the educational level of the school district area to be treated as time-invariant. The model follows the general form

$$(3) \qquad Y_{it} = \alpha + \beta X_{it} + P_i + €_{it}$$

Where Y is student performance in school district i at time t, X is a vector of time varying factors (expenditures, local income), P is a school district specific error term of time-invariant factors, and € is a typical error term for school district *i* at time *t*. This results in a null hypothesis of H_o: $\beta=0$, where β is a vector of the coefficients of school district expenditures and an alternate hypothesis of H_a: $\beta\neq0$. Should the null hypothesis be correct, it would mean that expenditures have no effect on student outcomes and that any additional funding spent on public education is wasted, as allocation and expenditure per student are unrelated to student success. However, should β not equal zero, then it would imply that differing school allocations do have an impact on student outcomes, and should the condition

$$\frac{\partial Y}{\partial_{sal}} = \frac{\partial Y}{\partial_{ben}} = \frac{\partial Y}{\partial_{supp}} = \frac{\partial Y}{\partial_{prop}} = \frac{\partial Y}{\partial_{serv}}$$

not hold, then school districts are not allocating their funds efficiently.

Results

Table 2 contains the results from the fixed-effects model specified in equation 3. Individual school district fixed effects have been omitted for clarity. Column 1 contains results when regressing on average percent proficiency across all three subjects. Column 2-4 use individual subjects: math, science, and ELA respectively. The same independent variables were included in each model: salary, benefits, supplies, property, and services per student. Table 2 contains indicator estimates when expenditures are standardized, Table 3 contains the exact same models with expenditures in per-student hundreds of dollars

Salary across all subjects was consistently significant and negatively related to student performance. Each expenditure variable is standardized to a mean of 0 and a standard deviation of 1, so the interpretation for total salary per student on student performance is that a one-standard-deviation increase in total salary per student leads to a 19-percentage point *decrease* in average student proficiency. Total benefits per student, consistently had a positive relationship to higher proficiency, and was statistically significant when explaining total average proficiency, proficiency in science, and proficiency in ELA. Total supply expenditures per student were not consistently related to proficiency in either a positive or negative direction, and were insignificant except in regards to mathematics, where it had a negative relationship to proficiency levels. Total property expenditures per student were consistently insignificant, as were total service expenditures per student.

Salary and benefits were consistently highly correlated because of the nature of compensation. To address concerns of possible multicollinearity, each was dropped during the analysis. Point estimates using only one or the other still retained the same sign, so neither was dropped from the final model.

The negative relationship with regards to salary may initially be surprising, as it would follow standard wage efficiency theory to expect better student outcomes when salaries are higher. However, benefits had a consistently positive relationship with student outcomes, leading to interesting possibilities regarding compensation type: if wage efficiency theory holds, this analysis finds that compensation in the form of benefits has a far greater effect on output than compensation in the form of salaries, potentially indicating the marginal utility placed upon benefits being higher than those on wage. To illustrate this, an increase in salary of $50 for an individual may be less beneficial than the application of that $50 towards a monthly insurance premium.

Regardless, these results indicate that school district budget allocations in Utah are not currently efficient. The application of funding in Utah currently has differing effects depending on where it is applied: a negative coefficient on salaries and a positive coefficient on benefits indicates that inefficiency exists within compensation for employees of these school districts. For example, if the average school district were to increase total benefits per student by one hundred dollars, the additional funds in the benefit category would lead to an increase in total average proficiency by 1.38 percentage points. However, rather than simply allocating additional funding, if that money were reallocated from salary, proficiency would improve by an additional

0.5 percentage points because of the negative relationship between salary and salary expenditures and proficiency. Such results indicate significant inefficiency in public schools in Utah.

Implications of Inefficiency

School districts can affect inefficiency in expenditures by reallocating their funds. Recall the efficiency condition denoted in equation 2.

$$(2) \quad \frac{\partial Y}{\partial_{sal}} = \frac{\partial Y}{\partial_{ben}} = \frac{\partial Y}{\partial_{supp}} = \frac{\partial Y}{\partial_{prop}} = \frac{\partial Y}{\partial_{serv}}$$

Results listed in Table 4 indicate that for proficiency in science, Utah school districts are not efficient. However, if policy makers or administrators wish to find an efficient outcome, this analysis can serve as a way to assist in that goal. For example, in Table 4, both supply expenditures and benefit expenditures have positive linear coefficients, and negative exponential coefficients. This implies decreasing marginal returns. If the goal is to maximize proficiency in science through the reallocation of supplies and benefits, then through the utilization of a restricted efficiency condition

$$(4) \frac{\partial Y}{\partial_{ben}} = \frac{\partial Y}{\partial_{supp}}$$

for the two expenditures of interest and a budget restriction requiring the reallocation of funds between the two expenditure types

$$(5)\ supp + benefit = \$$$

or

$$supp = \$ - benefits$$

where $ denotes the average total expenditure of both expenditure types, we can determine the efficient allocation of both supplies and budget expenditures.

Using the abbreviated functional form of Table 4

$$(6)\ Y_{it} = \beta_0 + \cdots + \beta_3\text{benefits} + \beta_4\text{benefits}^2 + \beta_5\text{supplies} + \beta_6\text{supplies}^2 + \cdots + €_{it}$$

where

$$(7)\ \frac{\partial Y}{\partial_{ben}} = \beta_3 + 2\beta_4\text{benefits}$$

and

$$(8)\ \frac{\partial Y}{\partial_{supp}} = \beta_5 + 2\beta_6\text{supplies}$$

we can apply the reallocation budget condition in equation 5 to our efficiency condition (equation 4) to arrive at

(9)

$$\frac{\partial Y}{\partial_{ben}} = \frac{\partial Y}{\partial_{supp}} = \beta_3 + 2\beta_4\text{benefits} = \beta_5 + 2\beta_6\text{supplies}$$

$$\text{s.t. } supp = \$ - benefits$$

Simple algebraic substitution yields

$$(10)\ \beta_3 + 2\beta_4\text{benefits} = \beta_5 + 2\beta_6(\$ - benefits)$$

allowing estimates of coefficients and the average combined expenditure on supplies and benefits to be substituted in.

This process results in efficient allocation estimates for the average school district to be \$855.62 for supplies and \$2,197.26 for benefits.

Conclusion

Though schools in Utah are currently inefficient in the way they manage their expenditures, they could improve their student success outcomes by reallocating their funding to categories with a higher impact -- namely, from salary expenditures to benefit expenditures. As salary expenditures had a negative effect on student achievement, increasing teacher salaries would not improve, but decrease student success. While it may seem counterintuitive, decreasing salaries while simultaneously increasing benefits for teachers would be a more effective allocation of education funding.

Researchers could expand this project by analyzing standardized testing and expenditure data for school districts in other states or nationwide. This would allow for a greater sample size, and conclusions drawn from such research would give school districts a better idea of how their expenditures could affect student performance.

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Data Appendix:

Table 1

VARIABLES	(1) N	(2) mean	(3) Std. dev	(4) min	(5) max
Percent Proficient Math	238	0.718	0.0979	0.415	0.919
Percent Proficient Science	238	0.715	0.0915	0.444	0.869
Percent Proficient ELA	238	0.834	0.0620	0.614	0.934
Real income per capita	240	32,391	13,163	19,939	83,598
General program benefits	237	1.415e+07	2.120e+07	447,411	1.287e+08
Special ed. program benefits	237	2.248e+06	3.287e+06	25,562	1.343e+07
App. Tech. program benefits	237	781,792	1.096e+06	21,839	5.612e+06
Total program benefits	237	2.109e+07	3.072e+07	360,066	1.617e+08
General program benefits	225	644,870	958,180	1	5.807e+06
Special ed. program property	210	49,739	90,157	116.8	571,872
App. Tech. program property	208	318,320	560,913	268	3.339e+06
Total program property	237	6.693e+06	1.082e+07	97,373	6.917e+07
General program salary	237	3.077e+07	4.400e+07	774,114	1.828e+08
Special ed. program salary	237	5.669e+06	8.219e+06	65,530	3.687e+07
App. Tech. program salary	237	1.837e+06	2.595e+06	83,218	1.451e+07
Total program salary	236	4.928e+07	7.005e+07	1.341e+06	3.105e+08
General program services	237	2.659e+06	3.215e+06	100,367	1.938e+07
Special ed. program services	237	270,041	432,201	1,005	3.082e+06
App. Tech. program services	236	146,683	258,386	197.5	2.504e+06
Total program services	237	1.292e+07	2.281e+07	177,480	1.361e+08
General program supplies	237	5.774e+06	8.121e+06	142,955	4.035e+07
Special ed. program supplies	237	125,790	183,020	745.1	1.012e+06
App. Tech. program supplies	236	195,678	304,580	470.3	1.838e+06
Total program supplies	237	9.775e+06	1.347e+07	213,871	6.146e+07
Total general expenditures	237	5.385e+07	7.557e+07	1.708e+06	3.313e+08
Total Special ed. expenditures	237	8.423e+06	1.207e+07	102,430	5.236e+07
Total App. Tech expenditures	237	3.447e+06	4.828e+06	145,570	2.591e+07
Total program expenditures	237	1.078e+08	1.512e+08	261,398	7.021e+08
Total salary per student	236	4,581	1,389	2,365	11,403
Total benefits per student	237	2,051	726.2	635.0	5,396
Total services per student	237	1,292	1,708	215.8	14,142
Total supplies per student	237	1,002	372.9	377.2	2,558
Total property per student	237	808.5	1,351	84.63	14,400

Table 2

VARIABLES	(1) Avg. proficiency	(2) Math	(3) Science	(4) ELA
Std. total salary per student	-0.1900**	-0.1190*	-0.2769**	-0.1740**
	(0.034)	(0.049)	(0.057)	(0.041)
Std. total salary per student sq.	0.1712**	0.1335**	0.2369**	0.1430**
	(0.036)	(0.049)	(0.079)	(0.038)
Std. total benefits per student	0.1057**	0.0663	0.1344**	0.1163**
	(0.029)	(0.048)	(0.043)	(0.032)
Std. total benefits per student sq.	-0.0790**	-0.0241	-0.1154*	-0.0976**
	(0.027)	(0.054)	(0.049)	(0.029)
Std. total supplies per student	-0.0070	-0.0372**	0.0140+	0.0022
	(0.006)	(0.008)	(0.008)	(0.007)
Std. total property per student	0.0000	-0.0005	0.0002	0.0004
	(0.001)	(0.005)	(0.002)	(0.002)
Std. total services per student	-0.0030	-0.0064	-0.0046	0.0020
	(0.003)	(0.005)	(0.004)	(0.003)
Real Income per capita	0.0000	0.0000	-0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.7264**	0.6162**	0.7394**	0.8237**
	(0.031)	(0.070)	(0.025)	(0.025)
Observations	235	235	235	235
R-squared	0.3634	0.2751	0.3332	0.2145
Number of district_no	40	40	40	40
District FE	Yes	Yes	Yes	Yes

Table 3

VARIABLES	(1) Avg. proficiency	(2) Math	(3) Science	(4) ELA
Total salary per student ($100s)	-0.0138**	-0.0071+	-0.0210**	-0.0133**
	(0.003)	(0.004)	(0.005)	(0.003)
Total salary per student ($100s) sq.	0.0001**	0.0001*	0.0001**	0.0001**
	(0.000)	(0.000)	(0.000)	(0.000)
Total benefits per student ($100s)	0.0146**	0.0088	0.0187**	0.0162**
	(0.004)	(0.007)	(0.006)	(0.004)
Total benefits per student ($100s) sq.	-0.0002**	-0.0001	-0.0003*	-0.0003**
	(0.000)	(0.000)	(0.000)	(0.000)
Total supplies per student ($100s)	-0.0014	-0.0162*	0.0084	0.0037
	(0.004)	(0.007)	(0.005)	(0.003)
Total supplies per student ($100s) sq.	-0.0000	0.0002	-0.0002	-0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
Total property per student ($100s)	0.0000	-0.0001	0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Total services per student ($100s)	-0.0002	-0.0004	-0.0002	0.0001
	(0.000)	(0.000)	(0.000)	(0.000)
Real Income per capita	0.0000	0.0000	-0.0000	0.0000
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.9389**	0.7785**	1.0548**	0.9834**
	(0.066)	(0.125)	(0.075)	(0.061)
Observations	235	235	235	235
R-squared	0.3634	0.2773	0.3357	0.2167
Number of district_no	40	40	40	40
District FE	Yes	Yes	Yes	Yes

Table 4

VARIABLES	(1) Science
Total salary per student	-0.0002**
	(0.000)
Total salary per student sq.	0.0000**
	(0.000)
Total benefits per student	0.0002**
	(0.000)
Total benefits per student sq.	-0.0000*
	(0.000)
Total supplies per student	0.0001
	(0.000)
Total supplies per student sq.	-0.0000
	(0.000)
Total property per student	0.0000
	(0.000)
Total services per student	-0.0000
	(0.000)
Real Income per capita	-0.0000
	(0.000)
Constant	1.0548**
	(0.075)
Observations	235
Number of district_no	40
R-squared	0.3357
District FE	Yes