



2016

Modelling Public-Education Spending vs. Allocation as Independent Factors of Educational Outcomes

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Recommended Citation

Tasley, Kevin (2016) "Modelling Public-Education Spending vs. Allocation as Independent Factors of Educational Outcomes," *Undergraduate Economic Review*: Vol. 13 : Iss. 1 , Article 10.

Available at: <https://digitalcommons.iwu.edu/uer/vol13/iss1/10>

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Modelling Public-Education Spending vs. Allocation as Independent Factors of Educational Outcomes

Abstract

This paper explores and expands upon the work of Hanushek and Wößmann (2007) whose accumulated findings propose increased educational spending provides only marginal returns in terms of student's cognitive outcomes. This study constructs an OLS regression model to explore the significance of U.S. state education spending and financial allocations as independent factors of state-level average ACT scores over a 10-year time series. The model additionally accounts for self-selection and socio-economic status. The results of this study support Hanushek and Wößmann's conclusions while also demonstrating evidence that shifts in allocations towards instructional spending, as opposed to increasing total expenditures, could have a more substantial impact on returns to educational quality.

Keywords

Education, United States, Student Outcomes, Econometrics, Spending, Allocation, Public Finances

Cover Page Footnote

Great thanks to my mentors throughout my research process: Dr. Adam Gilbert and Dr. Megan Sawyer. Teachers' passions for academics and student success is among the most powerful tool for creating a more equitable and just humanity.

1. The Need to Understand Factors of Education Quality

Despite numerous economic advantages, the United States continues to produce educational outcomes below that of its international peers (OECD 2012). The economic impacts of education quality take years to manifest, yet the results are clear: educational quality has significant impact on individual incomes, the distribution of income and economic growth (Hanushek and Wößmann, 2007). To develop policies that most effectively improve educational quality with available resources, public policy makers need to understand how public-educational resource management relates to education quality. This study explores and expands upon the work of Hanushek and Wößmann (2007) whose accumulated findings propose that education quality, as opposed to quantity, has a significant impact on economic growth. Hanushek and Wößmann propose increased spending on education has only marginal impact on actual education quality, but that school anonymity, accountability and teacher quality could be factors for future research. The focus of this study is to explore how Hanushek and Wößmann's broad assessment of educational spending from international studies perform on an intra-national level, while expanding their research to explore educational resource allocation, as opposed to comprehensive spending levels, as a factor of educational outcomes.

This study examines and compares how total education spending and spending allocation relates to ACT scores across the 50 U.S. states while accounting for socio-economic status and self-selection. This study analyzes these factors as constituent independent variables of an OLS regression model that uses state-level average ACT scores as the dependent variable, and subsequently, as a quantitative measurement of education quality.

2. Literature Review

Mankiw, Romer, and Weil (1992) find that education can increase the value of human capital in an economy, therefore raising the equilibrium level of production. Additionally, it would appear, according to Benhabib and Spiegel (2005), education is crucial in transmitting the knowledge needed to implement new technologies and processes associated with economic growth.

In 2003 the United States spent roughly 25-35% more on education per student than its developed peers, including Germany, Japan, and France, yet the United States scored roughly 10% lower on the 2003 Program for International Student Assessment administered by the OECD (Wößmann, 2007). While the United States outspends its peers, yet returns PISA scores lower than those spending significantly less, Hanushek and Zhang (2006) find that the United States demonstrates the largest percentage returns to cognitive skills across the countries participating in the PISA examination. Hanushek and Zhang define this return to cognitive skills as the percentage increase in earnings per

standard deviation of increased literacy rate. The United States sees an increase in earnings of roughly 24% per standard deviation increase in literacy, the highest of all nations covered in PISA and significantly greater than the average of roughly 7%.

Wößmann (2007) examines data from the 2003 results of PISA and finds that a quadrupling of education expenditures per student is associated with roughly a one-half standard deviation improvement in scores. The removal of two outliers, Mexico and Greece, from the regression demonstrates that there is no significant increase found between education spending per student and a countries' PISA performance.

Hanushek and Wößmann (2007) examine exhaustive evidence that shows educational quality directly affects individual earnings more significantly than measurements of simple access, resources devoted to education, or years of schooling attained. They present evidence showing that this finding holds true amongst groupings of both developed and undeveloped nations. As this study focuses on the United States, where 90.83% of the population ages 25-29 have a high school diploma (US Census Bureau, 2003), the need to focus on the quality of education is even more applicable than issues of access or levels of attainment. Hanushek and Wößmann (2007) go on to present new findings that educational quality matters even more for national economic growth. They find that "test scores that are larger by one standard deviation (measured at the student level across all OECD countries in PISA) are associated with an average annual growth rate in GDP per capita that is two percentage points higher over the whole 40-year period" (Hanushek and Wößmann, 2007).

It is clear that education quality, as measured by levels of cognitive skills, is the dominant determining factor in education outcomes rather than the often discussed and cited levels of resources and attainment. The broad question remains: What factors affect education quality itself, and of those factors, what can policy makers readily influence? Hanushek and Wößmann (2007) conclude their study with indeterminate results on the most important drivers of education quality itself. Three factors are mentioned with marginal supporting evidence as avenues to explore in future research: School accountability, school autonomy and teacher quality.

While Hanushek and Wößmann's work demonstrates the relative inefficacy of unilaterally increasing resources available for educational efforts, this study examines variables representing both educational spending and spending allocation. Findings from this study support Hanushek and Wößmann's results, while additionally demonstrating the contribution of allocation to the measurement of education quality. This study models and assesses the correlations between household income levels, public education spending levels and specific public education allocations within the United States at the state level between representative ACT scores.

3. Economic Theory

The United States appears to present an intriguing case for study: In terms of education, the U.S. outspends its peers on a per student basis (Wößmann, 2007), it returns international test scores below its peers categorically in both spending and level of development (OECD, 2012), and yet has the highest apparent potential for economic returns in individual earnings per incremental increase in education quality (Hanushek, 2006). When comparing quality of educational outcomes, it is important to consider the levels of institutional infrastructure between locales from which educational measurements are compared (Hanushek and Wößmann, 2007). Levels of access and attainment, while apparently marginal factors of educational outcomes according to Hanushek and Wößmann (2007) when compared to educational quality, do appear to play a larger role as a factor in developing nations. It is appropriate then to examine such factors within an environment where access and attainment are relatively consistent, as opposed to international comparisons. As a set of 50 states, each differing slightly in public education financial implementation, the United States presents a convenient set of altering resource policies on which researchers can compare educational outcomes within a similar macro institutional-maturity environment. The explorations in this study use a dataset compiled from time-series average composite ACT scores on a state-by-state basis over the years 2004-2014 as the dependent variable (*AvgCompositeScore*) to model independent factors of education quality.

The following is a list of the independent variables that constitute this study's exploration of the dependent variable (*AvgCompositeScore*) and the theoretical reasoning behind their selection:

PctTested: The percent of secondary-school graduates that were administered the ACT test in each state. The level of graduates that take the ACT test varies quite considerably across the states. Therefore is important to account for this variation when assessing the independent variables' contributions to the variation in ACT outcomes. While the purpose of this study is not to explore test-taker intent as a factor of outcomes of standardized testing, the results from this study clearly show a strong correlation between higher scores amongst states where administration of the ACT is more selective amongst graduates.

PerCapIncome: State-level average per capita household income. Cooper and Stewart (2013) at the London School of Economics screened and examined 46,668 studies relating household income levels to children's educational outcomes. Cooper and Stewart's exhaustive review conclude "there is strong evidence that households' financial resources are important for children's outcomes, and that this relationship is one of cause and effect." Similar to *PctTested*, if this study can accurately account for as much specific variation in outcomes of the dependent variable, we can more accurately measure the

domain across which spending and allocation are contributing factors. The results of this study present basic evidence in line with Cooper and Stewart's conclusion.

TotEduSpendPctGdp: Total state-level public-education spending as a percent of respective state gross domestic product. While analyzing data from the 2003 PISA scores, Hanushek and Wößmann (2007) conclude that increased spending on public-education amongst nations provides only marginal increases in scores. This variable attempts to assess Hanushek and Wößmann's international findings on an intra-national level (i.e. within the United States). Additionally, this study uses this variable to compare total education spending's contribution to the dependent variable's variation as compared to the more specific effects of education spending allocation. To appropriately compare differences in state administrations' spending levels, this variable is adjusted to become a percentage of total state gross domestic product. It should be noted that state-by-state spending levels, unadjusted for relative GDP, for each of the spending variables (including those to follow) were also explored but proved statistically insignificant.

To explore whether differences in allocations of educational spending are contributing factors of education quality, this study uses state-level educational spending reported as allocated to "Instructional Spending", "Support Spending", and "Other Spending" as variables for exploration. [This study recognizes how these variables (and others to follow) are potentially at least partially dependent upon each other and will discuss how potential multicollinearity between any and all of the variables was explored and accounted for.] Each of the three reported allocation variables have been adjusted to become a percentage of each representative state's total education spending and are as follows:

- *InstructSpendingPctTotal*: Total state-level public-education spending allocated to instruction as a percent of state total education spending. Of the variables dedicated to spending allocation, this variable most closely explores a venue of possible future research suggested at the conclusion of Hanushek and Wößmann's analysis: Teacher Quality. This study does not assess instruction spending as a measurement or representation of teacher quality, but recognizes the possibility for future analysis and the (albeit limited) parallels with Hanushek and Wößmann's conclusion.
- *SupportSpendingPctTotal*: Total state-level public-education spending allocated to student educational support services as a percent of state total education spending.
- *OtherSpendingPctTotal*: Total state-level public-education spending allocated to "Other" as a percent of state total education spending. This reported variable is ambiguous and this study will discuss possible implications based on the results.

4. Econometric Methodology

A. Dataset Discussed

To develop a dataset that would provide a large sample size, account for annual analogous fluctuations and provide room for changes in state spending policies to come to fruition, this study collected cross-sectional data over a ten-year time-series from 2004-2014 for each of the fifty U.S. states. The data for ACT scores and percent of high-school graduates tested in each state comes from the ACT¹ website. Both the per capita income data and the state gross domestic product data is from the Bureau of Economic Analysis website: [Bea.gov](http://bea.gov).² The public education spending data, including total spending and specific spending allocations, is from the National Center for Education Statistics website, [Nces.ed.gov](http://nces.ed.gov).³

The four variables *TotEduSpendPctGdp*, *InstructSpendingPctTotal*, *SupportSpendingPctTotal* and *OtherSpendingPctTotal* are derivatives of the education spending data collected from the Bureau of Economic Analysis website. To compare the public secondary-education spending between states, each state's education spending is adjusted as a percentage of each respective state's real gross domestic product. This adjustment allows for a level comparison of state-by-state education spending representative of their total available resources. With similar consideration, the state education spending allocation data has been adjusted as a percentage of each state's total education spending. In this way, this study attempts to compare how specific educational allocations, as a percentage of total resources devoted to education, impact the dependent variable. Utilizing relative spending and allocation also removes potential multicollinearity between the unadjusted total spending and allocation levels. Potentially complicating interaction between independent variables was screened through a variable correlation matrix presented below. The significant negative correlation between *InstructSpendingPctTotal* and *SupportSpendingPctTotal* is discussed and accounted for during the model development section. A correlation matrix for these variables is presented in Table 1.

¹ ACT Newsroom, (n.d.) Retrieved April 14th, 2016 from <https://www.act.org/newsroom/data.html> (accessed January 10th, 2016)

² U.S. Bureau of Economic Analysis, "Per Capita Personal Income Table 2004-2014," (n.d.), Retrieved April 14th, 2016 from http://www.bea.gov/iTable/index_nipa.cfm.

³ United States Census Bureau, "elsec04_sttables:elsec14_sttables," (n.d.), Retrieved April 14th, 2016 from <https://www2.census.gov/govs/school/>.

Table 1: Potential Variables' Correlation Matrix

Variable	<i>PCTtested</i>	<i>PerCapIncome</i>	<i>TotEduSpendPctGdp</i>	<i>InstructSpendingPctTotal</i>	<i>SupportSpendingPctTotal</i>	<i>OtherSpendingPctTotal</i>
<i>PCTtested</i>	1.00	-0.24	-0.04	-0.25	0.03	0.36
<i>PerCapIncome</i>	-0.24	1.00	0.16	0.27	-0.02	-0.42
<i>TotEduSpendPctGdp</i>	-0.04	0.16	1.00	-0.01	0.13	-0.19
<i>InstructSpendingPctTotal</i>	-0.25	0.27	-0.01	1.00	-0.82	-0.36
<i>SupportSpendingPctTotal</i>	0.03	-0.02	0.13	-0.82	1.00	-0.24
<i>OtherSpendingPctTotal</i>	0.36	-0.42	-0.19	-0.36	-0.24	1.00

Possible ACT scores range from 1-36 points, with an observed range of (17.8, 24.3), a mean of 21.43 points and a standard deviation of 1.19 points. Assessment of differences in state education spending and allocation practices will be concerned with changes across the domain of the minimum and maximum ACT scores as explained by changes across the range of minimum and maximum education spending and allocations. A range of 6.5 points in average ACT scores as a percentage of the maximum average score of 24.3 points represents a potential 26.75% performance premium of the highest performing state over the lowest.

The variable *TotEduSpendPctGdp*, or state's education spending as a percent of their GDP, has a minimum value of 2.06%, a maximum value of 5.77%, a mean of 3.44% and a standard deviation of 0.64%. This shows that differences in state's education spending policies vary by up to 3.72% of their total GDP which represents multi-billion dollar differences in education funding between states with comparable production levels. The state with the lowest *TotEduSpendPctGdp* (Nevada in 2005) spent just 36% (respective of state's relative GDP's) of what the state with the highest *TotEduSpendPctGdp* spent (Vermont in 2014). While this is obviously representative of the most extreme spending disparity, the range of the *TotEduSpendPctGdp* values as a percentage of the maximum spending, is 64.47%, clearly a spending range in which we can assess differences in educational outcomes.

The variable *InstructSpendingPctTotal* has a minimum value of 52.32% (Arkansas in 2011), a maximum value of 70.44% (New York in 2011), a mean of 59.75% and a standard deviation of 2.79%. Therefore, within the variable *InstructSpendingPctTotal*, states have chosen to spend differently on instruction as a percent of their total education

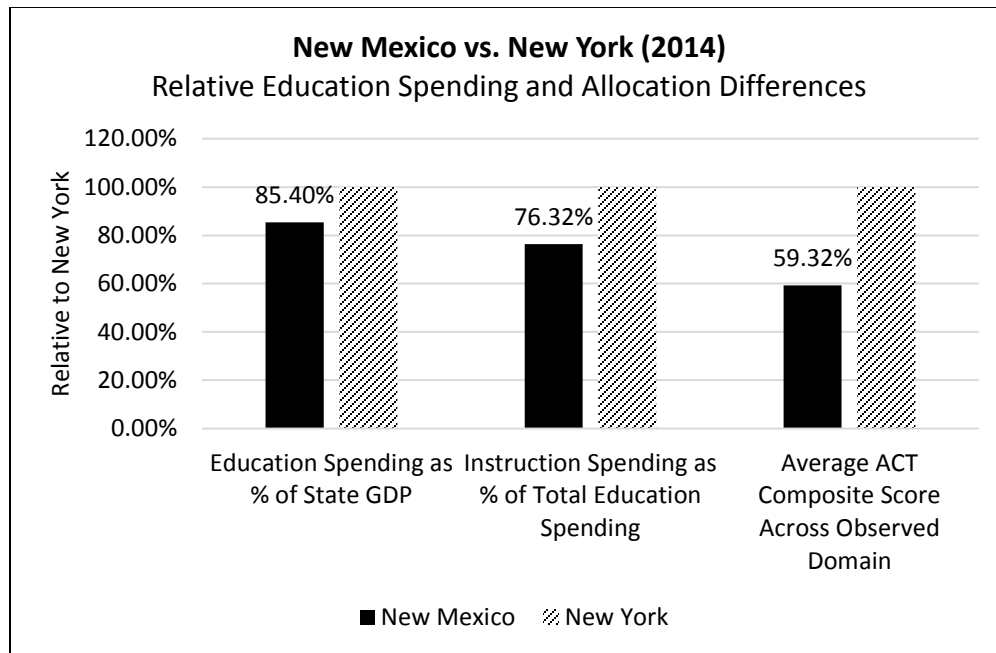
expenditures representing a range, or a maximum disparity of 18.12%. Once again, it is clear there is significant difference in state policy towards allocation of educational resources. A table outlining these statistics for each variable is presented in Table 2.

Table 2: Variable Data Statistics

Variable	<i>AvgComposite Score</i>	<i>PCTtested</i>	<i>PerCap Income</i>	<i>TotEduSpend PctGdp</i>	<i>Instruct SpendingPct Total</i>	<i>Support Spending PctTotal</i>	<i>Other Spending PctTotal</i>
Min	17.8	4	\$25,257.00	2.06%	52.32%	26.86%	2.64%
Max	24.3	100	\$64,864.00	5.77%	70.44%	41.66%	13.83%
Range	6.5	96	\$39,607.00	3.72%	18.12%	14.79%	11.19%
Mean	21.43	51.53	\$39,538.52	3.44%	59.75%	34.79%	5.46%
Std. Deviation	1.19	30.7	\$6,888.51	0.64%	2.79%	2.68%	1.67%
Std. dev. as % of Range	18.27%	0.6	17.39%	18.61%	4.67%	7.70%	30.55%
Range % of Max	26.75%	0.96	61.06%	64.47%	25.72%	35.50%	80.91%

An extreme example of total education spending and instruction allocation differences between the states with the highest and lowest levels of instruction spending as a percent of total education spending for 2014, New York and New Mexico respectively, is represented in relative terms in Figure 1.

Figure 1: Example of Relative Differences in Financial Education Policy Between States (2014)



B. Model Development Discussed

Each independent variable of interest (*PctTested*, *PerCapIncome*, *TotEduSpendPctGdp*, *InstructSpendingPctTotal*, *SupportSpendingPctTotal* and *OtherSpendingPctTotal*) was vetted using simple single variable OLS regression against the dependant variable *AvgCompositeScore*. While the variables chosen up to this point were each previously vetted for their potentially statistical significance and were proven to be so upon the basis of p-value, this round of vetting focused on each variable's contribution to explaining the variation in our dependent variable.

- *PctTested* returns a p-value < .001 and an r-squared of 0.344. While state-wide ACT testing rates of graduating high-school students vary between states from 4% to 100% of students tested, with a mean of 51.53%, it is clear that self-selection has potential as a strong factor of state-level ACT scores. This r-squared value supports this assumption, claiming the highest percentage explanation of variation in our dependent variable out of each of the independent variables.
- *PerCapIncome* returns a p-value < .001 and an r-squared value of 0.204. Elements of socio-economic status, such as household income, have proven significant in determining differences in educational outcomes across countless studies and specifically proven to have impacts on development in both measurements of language skills (Aikens & Barbarin, 2008) and early mathematical aptitude

- (Coley, 2002). The outcome of this single variable vetting confirms such previous research, with an r-squared accounting for roughly 20% of the variation in our dependent variable.
- *TotEduSpendPctGdp* returns a p-value $< .001$ and an r-squared value of 0.018. This simple analysis of correlation supports Hanushek and Wößmann's conclusion that, while spending on education is undoubtedly statistically significant in its correlation with educational outcomes, spending alone actually accounts for insignificant variation in outcomes and therefore provides little utility to policy makers looking to steer educational policy.
 - *InstructSpendingPctTotal* returns a p-value of $< .001$ and an r-squared value of 0.149. When attempting to determine whether factors of allocation (as opposed to simple measurements of spending) can help produce a better understanding of education quality and subsequent outcomes, *InstructSpendingPctTotal* becomes relevant. *PctTested* and *PerCapIncome* individually contribute 34.44% and 20.43%, respectively, of the variation in the dependent variable, therefore 14.85% of variation in *AvgCompositeScore* that is explained by *InstructSpendingPctTotal* potentially has a large impact on education outcomes.
 - *SupportSpendingPctTotal* returns a p-value of $3.54e-06$ and an r-squared of 0.037. While *SupportSpendingPctTotal* is clearly statistically significant, its individual R^2 contribution of 0.037 is marginally interesting. More importantly, it is logical to assume that there could be some form of relationship and interaction between the three allocation variables: *InstructSpendingPctTotal*, *SupportSpendingPctTotal* and *OtherSpendingPctTotal*. While there could be some interesting information to be gleaned within the variation in the relationship, each of the 3 allocation variables will obviously become functions of the other two; as one form of spending allocation decreases, at least one of the other two must increase etc. While this could be an interesting avenue of exploration, for the purposes of this study (our interest in practical interpretation of factors of educational quality), we are choosing to omit *SupportSpendingPctTotal* from the final model on the basis of both insignificant contribution to the variation in our dependent variable and for the potential implications of multicollinearity; *InstructSpendingPctTotal* and *SupportSpendingPctTotal* have a correlation of -0.82.
 - *OtherSpendingPctTotal* returns a p-value of $1.03e-15$ and an r-squared of 0.109. Interestingly, *OtherSpendingPctTotal* does not exhibit statistically high levels of correlation with the other two allocation variables, nor does it contribute an striking level of variation to our independent variable in simple OLS regression vetting. *OtherSpendingPctTotal*, when added to the final model as an additional factor, becomes less statistically significant at a 95% confidence level with a p-value of 0.102.

A summary of the statistical significance of the potential variables is presented in Table 3.

Table 3: Statistical Significance of Potential Variables Independently Regressed against AvgCompositeScore

Variable:	<i>PctTested</i>	<i>PerCap Income</i>	<i>TotEduSpend PctGdp</i>	<i>Instruct Spending PctTotal</i>	<i>Support Spending PctTotal</i>	<i>Other Spending PctTotal</i>
P-Value	< 2.2e-16	< 2.2e-16	0.0009789	< 2.2e-16	0.00000354	1.025E-15
R-Squared	0.3444	0.2043	0.01786	0.1485	0.03675	0.1093

Utilizing each variable's practical contribution to *AvgCompositeScore* narrowed the field of factors for a higher level model and subsequent analysis, yielding a 3 factor OLS regression model presented as Equation 1.

Equation 1: Final Model

$$\begin{aligned} \text{AvgCompositeScore} = & 15.53 - (.01823 \times \text{PctTested}) + \\ & (.00004991 \times \text{PerCapIncome}) + (8.153 \times \text{InstructSpendingPctTotal}) \end{aligned}$$

5. Results

A. Analysis of Final Model

This study's final model has a p-value of < 2e-16 and a R² of 0.480. The variables *PctTested* and *PerCapIncome* both produce p-values of < 2e-16 while *InstructSpendingPctTotal* has a p-value of 7.41e-09. It is quite interesting that roughly 50% of the variation in an average state's outcome for a test of student aptitude is explained by factors attributable to three relatively simple variables, two of which are economically derived. The model returns a residual standard error of 0.857 points. To put the standard error into context, the possible ACT scores are between 1 - 36 points, but to accurately assess the standard error we should look at the domain of scores (17.8, 24.3)

represented as state averages (*AvgCompositeScore*) in our data set. This puts the standard error for our final model at 13.18% of the domain of scores represented in the dataset. The final model's statistical results are presented in Figure 2.

Figure 2: Statistical Analysis of Final Model

```
Call:
lm(formula = AvgCompositeScore ~ PCTtested + PerCapIncome
    + InstructSpendingPctTotal,
    data = ModelSet)
```

Residuals:

Min	1Q	Median	3Q	Max
-4.0464	-0.4891	0.0236	0.6824	1.8126

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.553e+01	8.283e-01	18.749	< 2e-16 ***
PCTtested	-1.823e-02	1.251e-03	-14.577	< 2e-16 ***
PerCapIncome	4.991e-05	5.609e-06	8.898	< 2e-16 ***
InstructSpendingPctTotal	8.153e+00	1.388e+00	5.874	7.41e-09 ***

 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8568 on 546 degrees of freedom
 Multiple R-squared: 0.4826, Adjusted R-squared: 0.4797
 F-statistic: 169.7 on 3 and 546 DF, p-value: < 2.2e-16

A test of the model's predictive performance against a year of average state ACT scores not included in the dataset used to produce the model (2003) returns a median standard error of 0.899, similar to the model's standard error of 0.857. A graphic comparison of the predicted average state scores to the actual average state composite scores for 2003 is presented in Figure 3. The average margin of error for the 2003 prediction test is 3.96%. A graph of the standard error and margin of error for each state prediction for 2003 is presented in Figure 4. The year of 2003 was chosen as the closest chronological year with available data to the data used (2004-2014).

Figure 3: Final Model Prediction Performance

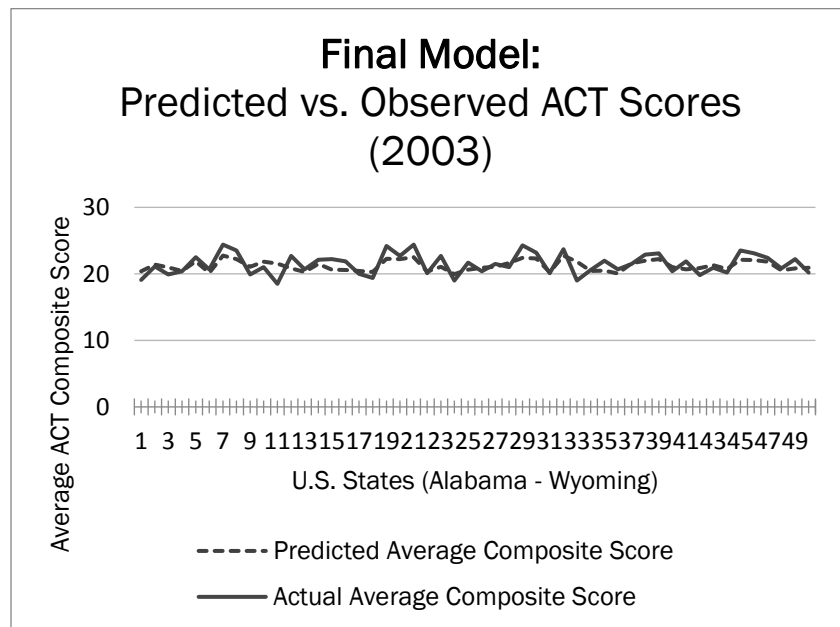
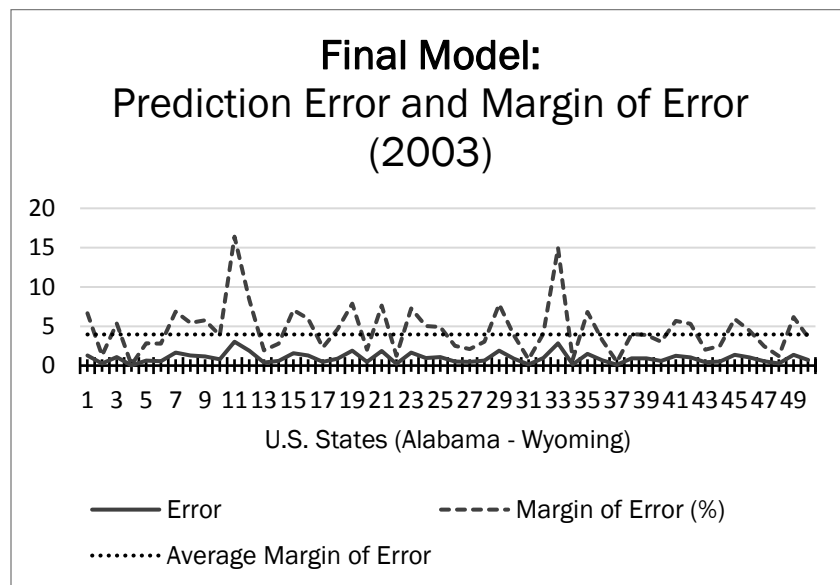


Figure 4: Final Model Prediction Margin of Error



B. Statistical Analysis of *TotEduSpendPctGdp* and *InstructSpendingPctTotal*

Our final model demonstrates the potential of the levels of spending allocation devoted to educational instruction as a factor of our measurement of educational outcomes while accounting for self-selection and a one dimensional measurement of socio-economic status. To more thoroughly compare the correlation of broad education spending compared to the correlation of a single measurement of allocation, we have taken a cross-section of our data for deeper statistical inspection. When the data from 2014 is isolated, we see *TotEduSpendPctGDP*, outside of a multifactor model, accounting for 6.81% of variation in *AvgCompositeScore*, while *InstructSpendingPctTotal* accounts for 24.47% of variation in the same scores. Looking at the relationship between *AvgCompositeScore* and *InstructSpendingPctTotal* within our dataset, we see for every 2.79%, or one standard deviation, increase in fixed state education spending allocated towards instruction spending, we see a correlated 15.38% increase in *AvgCompositeScore* across the observed domain of scores. Correlation plots for *AvgCompositeScore* vs. *TotEduSpendPctGDP* and *InstructSpendPctTotal* are presented in Figures 5 and 6 respectively. While such independent variable inspection is simple correlation, we understand from the development of this study's final model that *InstructSpendingPctTotal* is statistically significant far beyond the 99% confidence level in this study's final model. With measurements of *PctTested* and *PerCapIncome* each individually accounting for significant variation in *AvgCompositeScore* themselves, *InstructSpendingPctTotal*'s account for variation in the dependent variable of the final multi-factor model becomes all the more practically significant as an observation for educational policy and administrative applications.

Figure 5: AvgCompositeScore vs. TotEduSpendPctGDP (2014)

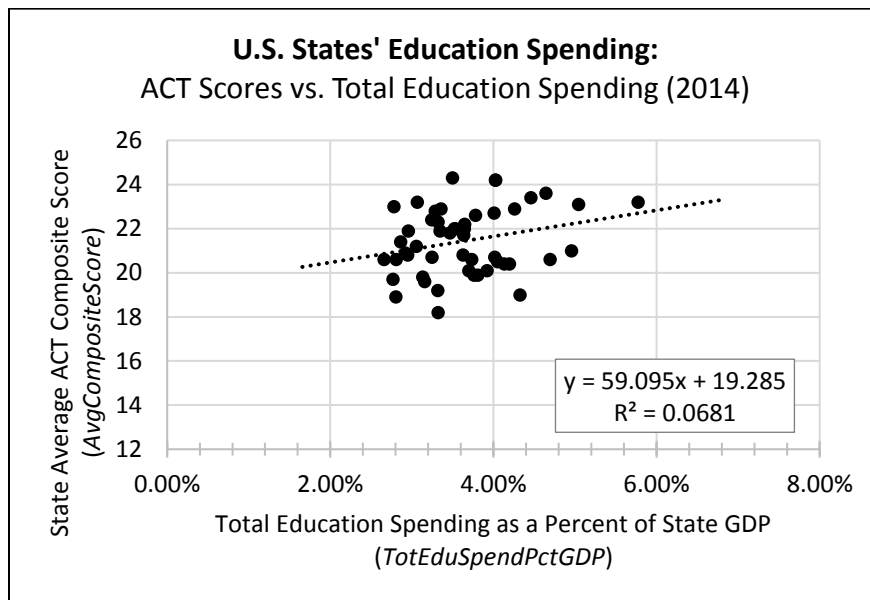
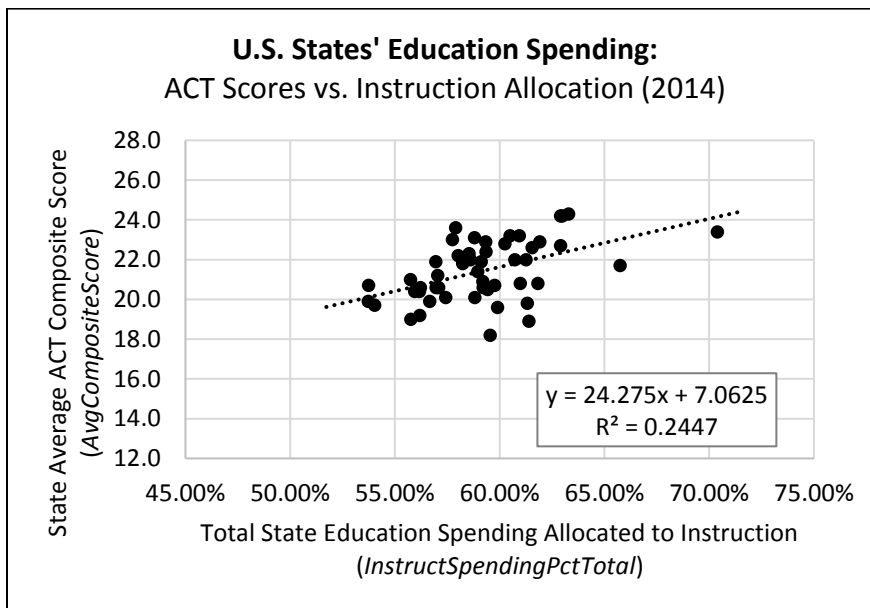


Figure 6: AvgCompositeScore vs. InstructSpendPctTotal (2014)



6. Conclusion

The results of this study support Hanushek and Wößmann's ultimate conclusion that while broad measurements of education spending are strongly correlated with cognitive measurements of education quality, spending alone provides only marginal contribution to explaining such outcomes. It is little surprise then when we inspect more specific factors of spending, in this case spending specifically allocated towards instruction, we continue to find strong statistical significance. As we begin to dig deeper into specific factors of spending we may begin to develop an understanding of the contribution such factors have towards education outcomes. In this case, it is clear that the level of spending allocated towards instruction is a factor of education outcomes that we can manage with administrative adjustments for appreciable gains. While initially inspecting for practical confirmation of this statistical conclusion by comparing differences in states with relatively small shifts in allocation towards instruction, we see a consistently strong correlation with increased educational outcomes. We should note the care in which this observation must be implemented. Further research is needed to understand where the funds for increased instruction allocation is shifted from in these cases and at what level the greatest efficiencies in instruction allocation are to be had.

Resources devoted towards education are indeed factors of education quality, but how these resources are distributed and managed throughout the education system are ultimately much more important than the simple policy decision of increasing or decreasing overall funding. Subsequent avenues of research to be addressed involve improving our understanding of the elements of publicly reported "instruction spending", and investigation into the efficient utilization of instruction spending, as well as continued research into other segments of educational resource allocation's effects on cognitive outcomes.

Works Cited

Aikens and Barbarin. 2008. "Socioeconomic differences in reading trajectories: The contribution of family, neighborhood, and school contexts." *Journal of Educational Psychology*.

Benhabib and Spiegel. 2005. "Human Capital and Technology Diffusion." In Philippe Aghion and Steven N. Durlauf, eds., *Handbook of Economic Growth*. North Holland, Amsterdam.

Coley. 2002. "An Uneven Start: Indicators of Inequality in School Readiness." Princeton, NJ: Educational Testing Service.

Cooper and Stewart. 2013. "Does Money Affect Children's Outcomes? A Systematic Review." Centre for Analysis of Social Exclusion, London School of Economics and Political Science, London.

Hanushek and Wößmann. 2007. "The Role of Education Quality in Economic Growth." Policy Research Working Paper 4122, World Bank, Washington, D.C.

Hanushek and Zhang. 2006. "Quality Consistent Estimates of International Returns to Skill." Working Paper 12664, National Bureau of Economic Research, Cambridge, Mass.

Mankiw, Romer and Weil. 1992. "A Contribution to the Empirics of Economic Growth." *Quarterly Journal of Economics* 107.

Organization for Economic Cooperation and Development (OECD), Program for International Student Assessment (PISA), 2012.

Shonkoff, (Editor), Phillips (Editor). 2000. Committee on Integrating the Science of Early Childhood Development. "From Neurons to Neighborhoods: The Science of Early Childhood Development." National Academies Press, Washington, DC.

US Census Bureau Report on Educational Attainment in the United States, 2003.

Wößmann. 2007. "International Evidence on Expenditure and Class Size: A Review." *Brookings Papers on Education Policy*, Washington D.C.