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**Does Principal Pay Matter?
An Analysis of Principal Compensation and School Performance
in Colorado K-12 Public Schools**

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Abstract

Compensation of K-12 school principals, and the effect that it has on the performance of the schools they lead, has become a relevant policy debate in recent years. This study examines the relationship between principal salaries and student performance on Colorado Student Assessment Program (CSAP) tests by using multivariate quintile regressions on data from the 2002-2005 school years. Controlling for differences in cost of living across districts, a positive correlation between principal salaries and student CSAP scores was found, particularly in the mathematics section of the test. However, the percentage of a school's students on free and reduced lunch and teacher salaries were found to have a larger impact on student performance.

KEYWORDS: Principal, compensation, salary, education, leadership, CSAP, administration, school performance

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1. Introduction

Given the importance of principals, and the role of compensation in determining the quality of people who opt to pursue this career path, it is shocking that we know so little about principal compensation.

-D.Goldhaber (2007)

This paper explores the relationship between Colorado public school principals' compensation and the performance of the students they educate. Further, this study seeks to provide an understanding of the relationship between principal pay and performance across school time (specifically school years 2002-2005) and across performance levels (from lowest to highest performing schools on CSAP tests). Colorado was chosen as the geographic boundary of this research because it has some of the longest-lived, most standardized and most transparent education databases in the country and rich datasets were made available from the Colorado Department of Education.

The policy and academic implications of this paper's findings could be extensive, both in Colorado and in the national debate on education reform. Superintendants, school boards and lawmakers could use these findings to offer better incentives to principals, hold school leadership more accountable and make appropriate policy adjustments based upon differences in principal effectiveness across subjects and school performance levels. Further, implications—or at least areas for further research—could be extended to leadership compensation and performance in other social and public fields. Alternatively, these findings could add to the growing study of compensation in education, especially those related to educational leadership.

This paper proceeds with a review of the related literature on school performance and education-related compensation in Section 2. The subsequent section describes our data, their advantages and limitations, along with the quintile regression methodology we apply to them. Section 4 presents our econometric results, while Section 5 concludes with the implications for policy.

2. Literature Review

Appraising the effectiveness of schools has become a political flashpoint, a source of intense academic debate and a critical component of education policy decisions. For example, Lee and Burkam (2003) evaluated drop-out rates and found that school organization and structure have a significant impact on high school students' attrition. The strength of student-faculty relationships, school size and academic offerings were all important determinants in students' decisions to drop out of high school, suggesting that smaller, academic-focused schools with compassionate teachers are best at keeping students through graduation.

Despite the controversy concerning the type of assessment, standardized tests have become the norm in assessing school performance, so some work has been done on determining factors of success in test-taking. Dolton, et al.'s (2003) model, using a case study of highly structured lessons and exams in a Spanish university, suggests that formalized study is perhaps four times more effective at boosting test scores than individual study. These findings suggest that classroom preparation does indeed have a significant impact on students' performance on standardized tests.

The most highly politicized, hotly debated and constantly evolving aspect of education policy is teacher compensation, which is directly applicable to this study. In

their exhaustive study of Texas public schools and teachers, Hanushek and Rivkin (2007) determine that salaries have a significant impact on both teacher retention and long-term student performance, leading them to advocate for compensation tied more closely to student performance, rather than traditional metrics like education level and experience. Interestingly, teachers that demonstrate the most trust in their principal are most likely to favor pay-for-performance programs, as was found in a recent survey of Washington state public school teachers. These findings suggest that teachers are more willing to have their effectiveness (via student achievement in this case) evaluated if they believe in the person leading them—a strong case for the effect of principal leadership on faculty outcomes (Goldhaber et al., 2007).

A small but growing literature exists on K-12 school leaders, ranging from mobility to qualifications with some discussion of performance and effectiveness. In their seminal 1988 article, Ehrenberg et al. (1988) revealed that New York superintendents moved between districts for salary increases more than any other factor and their pay structure was surprisingly tied to tax rates more than anything else. Notably, student achievement, school performance, standardized test score results or any other measure of successful outcomes had little to no bearing on superintendant mobility. In more recent work, Akiba and Reichardt (2007) revealed those findings held constant for Colorado principals who, in their study, were motivated to change schools by pay and advancement possibilities more than their ability to improve student performance, though “student achievement” was a minor motivating factor in mobility.

The *Schools and Staffing Survey* of 2003-04 provides the richest set of data on principals’ salaries across the country but little has been done with the dataset. Goldhaber

(2007) presented a few regressions on the dataset to determine that school profiles (such as size and demographics) and principal attributes (such as degree attained and experience) do have some significance on determining compensation; however, his report asks far more questions than it provides answers. Using the same numbers, Billger (2007) explored the relationship between school accountability and principal salaries to find, interestingly, that principals receive *lower* salaries in schools required to meet state, local and district accountability goals. There are a number of explanations offered to account for this, namely that lower performing schools are often in less funded districts. That report will inform this paper greatly but it is important to note that since all Colorado schools are required to meet state accountability standards, Billger's findings are not expected to impact the results.

3. Data and methodology

Constructing a model capable of completely isolating the effect of principal compensation on school performance is difficult given the numerous factors that affect student achievement on standardized test scores. However, by including the most influential variables on student performance (as determined by previous research) in these models, we hope to shed some new light on the role of administrative compensation.

The Colorado Department of Education has administered an annual state-mandated standardized test in math, reading and writing to every student in Colorado public schools grades 4-10, every February since 1997. The dependent variable "CSAP score" is the percentage of students within a school that receive a score of proficient or above on the CSAP test in the given testing section [mathematics ("math"), reading

(“read”) and writing (“writ”)], with each section considered separately. By state law, school scores have to be recorded and published, and were therefore easily accessible through the CDE (Colorado Department of Education, 2009).

We propose a simple linear reduced form explanation for those CSAP scores:

$$\begin{aligned} \text{CSAP score} = & \beta_0 + \beta_1 \text{logadmin} + \beta_2 \text{logteach} + \beta_3 \text{lunch} \\ & + \beta_4 \text{stratio} + \beta_5 \text{conduct} + \beta_5 \text{localshare} \\ & + \beta_6 \text{perpupilfund} + u \end{aligned} \quad (1)$$

where CSAP score is the percentage of students in a given school who score at the proficient level or higher in the (math/reading/writing) section of the CSAP test;

Logadmin is the log of the average administrative/principal salary in the school, adjusted for local cost of living;

Logteach is the log of the average teacher salary in the school, adjusted for local cost of living;

Lunch is the percentage of students in the school who qualify for federal free or reduced-fee lunch programs;

Stratio is the average student to teacher ratio in the school;

Conduct is the number of reported conduct code violations per student in the school;

Localshare is the percentage of total school district revenue contributed by local property taxes; and

Perpupilfund is the total school district revenue divided by the total number of students enrolled in the district.

There is significant variance in each of the three CSAP test sections, as Table 2 reports. On one hand, at least one school in every testing subject had every single student score proficient or above on the CSAP, resulting in the perfect 100 maximum for the “math”, “read” and “writ” variables. On the other hand, at least one school managed to only have one in every ten students achieve a proficient or above CSAP score in the same three subjects, resulting in minimum bounds of 7, 11 and 8 for the “math”, “read” and “writ” variables, respectively. It is due to this enormous variation that we will use quintile, rather than OLS, regressions in the analytical stage of this study.

Table 1: Summary statistics

Variable	Mean	Median	Minimum	Maximum	Standard Deviation
math	54	56	7	100	23
read	66	69	11	100	18
writ	52	53	8	100	19
logadmin	4.75	4.87	3.36	5.27	0.19
logteach	4.52	4.54	3.09	4.81	0.11
lunch	0.30	0.25	0.00	0.97	0.24
stratio	15.9	15.7	4.8	44.2	9.3
conduct	0.14	0.05	0.00	0.88	0.06
localshare	0.36	0.36	0.13	0.87	0.15
perpupifund	7326	7181	3425	12563	1757

While it would have been ideal to acquire the exact salary of the principal in each school, the CDE data set only includes average salaries of all administrators per school. However, the average number of administrators per school is 1.4 between 2002 and 2005, so there should not be too much intra-school variation to muddy the variable’s primary purpose.

We adjusted each administrator (and teacher) average salary using the yearly “cost of living factor” (COL) determined by the CDE to calculate the school finance formula. The CDE performs an annual evaluation of the relative cost-of-living in each of

the 178 school districts in Colorado and publishes its findings in an index used as one of the numerous factors that go into determining state contributions to districts. The COL is an index from 1.00 to around 1.7 (depending on the year), with all 178 districts assigned a unique index score. For instance, the Aspen School District received a 1.64 COL index score for the 2003-2004 school year, giving it the highest cost-of-living in the state. In the same year, Stratton R-4 (a small district 150 miles east of Denver on I-70) was assigned only a 1.07 index score, making it one of the cheapest districts in which to live. Each raw administrator salary was simply divided by the cost of living factor to find the adjusted administrator salary.

“logteach” is the log of the average adjusted salary of the teachers in each school. Naturally, just as administrator salaries needed to be adjusted for the differing cost of living in districts across the state, we adjusted teachers’ salaries using the same calculation.

“lunch” is the percentage of students within each school on free or reduced lunch, as determined by the National School Lunch Program (USDA, 2009). This serves as a proxy for the relative wealth of the students that attend each school, since this federally standardized data is widely regarded as an accurate reflection of average family wealth.

“stratio” is the average student to teacher ratio per school and was calculated using data provided by the CDE which had student to teacher ratios for every grade level per school.

“conduct” is the number of yearly conduct code violations per pupil in each school. This statistic was calculated by the author using the formula proposed in Nakagawa (2007), which consists of dividing the total number of conduct violations

reported by the school in a given year by the total enrollment of the school. This statistic will serve as a proxy for the relative behavioral problems of the school, with the average school reporting 0.14 conduct violations per student per year and significant statistical range from no conduct violations per year (0.0 minimum) to almost 1 per student per year (0.88 maximum).

“localshare” is the percentage of total district revenue contributed by local taxes. This statistic was easily calculated using the district revenue breakdowns provided by the Colorado Department of Education, and serves as a proxy for district wealth, since contributions from local taxes is largely based upon local property values, with local communities contributing an average of 36% of the total revenues of districts. Obviously, the rate at which local communities are taxed is based upon the community’s *willingness* to be taxed (expressed through local mill levy elections) which is independent of its *ability* to be taxed (the value of the property in the district). Still, this metric should be a roughly accurate judge of district wealth.

“perpupilfund” is the per pupil funding allocated by each district in a given year and was calculating by simply dividing the total revenue per district by the total number of students in the district.

The data in this paper represent over 1,700 public schools in Colorado, only excluding those where principal compensation data or Colorado Student Assessment Program (CSAP) scores were not available, and cover three school years: 2002-2003, 2003-2004 and 2004-2005. Each of the three CSAP scores (math, reading and writing) will be evaluated independently, but then obviously compared to draw any potential

aggregate lessons. Each analysis will be decomposed into quintiles at the 20th, 40th, 60th, 80th and 100th performance percentiles within each school year and CSAP testing section.

The use of logarithmic transformations on both salary variables was required to avoid multicollinearity problems in the regression process. Heteroskedasticity proved absent according to standard tests, and the Jarque-Bera test reported no evidence the errors are non-normal.

4. Results

Table 2 presents the results for the mathematics section of the CSAP test, while Table 3 compares all three sections of the CSAP test. Detailed results for the sections on writing and reading are available from the authors, but are summarized here.

Administrator salaries were found to have a positive effect in 11 of 15 quintiles shown in Table 3, 9 of them statistically significant, while none of the 4 negative coefficients were statistically significant. They were most significant in the 2003-04 school year, and were most significant in the mathematics CSAP scores (9 of 15 quintiles significant for math, but only 3 of 15 for reading, and 5 of 15 for writing). Considering that we control for other factors in these regressions, it appears that administrator salaries have a positive, or at least a benign effect, on CSAP test performance.

Results are similar for teacher salaries, with 12 of 15 coefficients showing a positive relationship with math performance (8 of them significant), and only one of the negative coefficients showing statistical significance. Interestingly, coefficients on teacher salaries are not categorically larger than the coefficients on administrator salaries, suggesting that pay to one group is not definitively more productive than pay to the other group, but rather depends on the context.

Table 2: Quintile regression results for CSAP Mathematics section

	2002-2003 (1557 observations)		2003-2004 (1580 observations)		2004-2005 (1708 observations)	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
Bottom quintile						
Logadmin	0.586	0.10*	17.78	2.97***	3.00	1.22
Logteach	32.56	5.90***	10.98	2.23**	9.71	2.93***
Lunch	-41.47	16.34***	-36.80	10.56***	-65.42	49.46***
Stratio	-0.48	1.70*	0.10	1.96*	-0.23	1.31
Conduct	-19.50	5.43***	-19.05	2.51**	-9.94	4.70***
Localshare	9.14	2.17**	13.25	2.15**	-9.82	3.49***
Perpupilfund	2.13×10^{-3}	4.96***	1.12×10^{-4}	0.19	1.24×10^{-3}	5.26***
Constant	-298.41	5.87***	-271.04	6.72***	-56.65	2.47**
Pseudo R ²		0.19		0.14		0.46
Second quintile						
Logadmin	3.28	0.99**	12.83	2.35**	1.51	0.63
Logteach	22.77	5.15***	10.55	3.05***	3.64	1.55
Lunch	-52.06	21.88***	-49.92	21.21***	-58.48	42.38***
Stratio	-0.11	0.56*	0.05	1.62	-0.21	1.38
Conduct	-21.5	8.04***	-20.67	3.51***	-9.46	5.77***
Localshare	8.07	2.70***	6.44	1.08	-12.09	5.36***
Perpupilfund	3.41×10^{-3}	4.19***	4.03×10^{-4}	0.68	1.01×10^{-3}	5.19***
Constant	-216.33	4.76***	-196.11	4.88***	31.40	1.40
Pseudo R ²		0.23		0.19		0.43
Third quintile						
Logadmin	7.07	1.96*	10.71	2.65***	-0.47	0.23
Logteach	11.10	1.88*	10.58	2.85***	0.08	0.03
Lunch	-61.06	28.23***	-55.31	29.31***	-54.62	37.93***
Stratio	-0.07	0.27	0.06	1.73*	-0.16	1.67*
Conduct	-21.37	4.38***	-23.08	3.84***	-10.84	7.7***
Localshare	7.74	2.09**	3.25	0.7	-13.17	7.92***
Perpupilfund	9.08×10^{-4}	3.16***	7.31×10^{-4}	1.16	1.00×10^{-3}	3.86***
Constant	-125.85	2.18**	-163.41	2.68***	95.48	5.22***
Pseudo R ²		0.24		0.22		0.39
Fourth quintile						
Logadmin	11.41	2.42**	10.88	2.55**	-2.49	1.04
Logteach	3.50	0.52	2.07	0.49	-1.97	1.01
Lunch	-67.08	17.24***	-55.89	17.39***	-47.56	26.89***
Stratio	-0.09	0.31	0.04	0.52	-0.16	1.53
Conduct	-14.70	2.20**	-14.55	1.37	-11.04	4.45***
Localshare	0.39	0.09	3.56	0.77	-10.82	5.06***
Perpupilfund	1.41×10^{-4}	2.72**	9.12×10^{-4}	1.68*	1.03×10^{-3}	5.02***
Constant	-80.08	1.24	-55.87	1.17	140.61	5.19***
Pseudo R ²		0.23		0.20		0.33

Table 2: Quantile regression results for CSAP Mathematics section (continued)

	2002-2003 (1557 observations)		2003-2004 (1580 observations)		2004-2005 (1708 observations)	
Top quintile						
Logadmin	-0.76	0.16	9.44	2.39**	-3.63	1.21
Logteach	8.58	1.46	-2.01	0.36	-5.12	-2.00**
Lunch	-42.31	6.74***	-34.59	5.39***	-26.82	6.06***
Stratio	0.06	0.21	-0.002	0.01	-0.03	0.47
Conduct	-7.94	1.16	-1.95	0.14	-4.71	1.39
Localshare	4.18	0.56	0.56	0.10	-5.12	1.13
Perpupilfund	1.04×10^{-3}	1.38	4.2×10^{-4}	0.72	1.34×10^3	1.28
Constant	11.13	0.20	11.71	0.21	189.37	5.06***
Pseudo R ²		0.17		0.19		0.18

* significant at 90%, ** significant at 95%, ***significant at 99% confidence levels.

Also interesting is the fact that both teacher and administrator salaries appear to be larger and more significant at lower quintile schools. This suggests that among high-performance schools, the relationship between salaries and performance is weaker than at lower-performance schools.

Turning now to the control variables, most effects show up as predicted. “Lunch” had a strong negative correlation with student performance, with coefficients significant and highly negative. Thus, small increases in the percentage of a given student body on the free and reduced lunch program translated to relatively significant decreases in student performance on CSAP tests. What is particularly striking is that the effect is not only the most significant of every independent variable tested, it is stronger than the effect of principal salaries in *all* years, testing sections and quintiles. Presumably this speaks to the power of household income as a determinant of academic success, through the channels traditionally outlined in the literature, including additional help at home by wealthier families and role-setting by more educated parents.

Conversely, average student to teacher ratios (“stratio”) only had statistically significant results in a few quintiles throughout the study, making it the variable with the smallest effect on student performance on CSAP tests. The vast majority of the “stratio” coefficients were negative and no lower than -0.5, meaning that increases in student to teacher ratios had the popularly expected negative effect on student performance. Notably, the handful of instances in which “stratio” was statistically significant were all in the lowest two quintiles. For most quintiles throughout the results, administrator salaries had a stronger effect on student performance than student to teacher ratios, though not conclusively so.

The number of conduct code violations per student per year (“conduct”), included as a proxy for the behavioral and environmental challenges of schools, proved statistically significant in 10 of 15 quintiles for every testing section, with significance ranging across every year. Its coefficients were, almost without exception, negative (and the few positive coefficients were all statistically insignificant). This inverse relationship accords with intuition, meaning that an increase in the number of annual per pupil conduct violations had a negative effect on student performance on CSAP tests across math, reading and writing. Generally speaking, the effect of “conduct” on student performance was not decidedly more than “logadmin”.

The percentage of total district revenue contributed by local taxes, “localshare”, has the expected positive coefficient in 12 of 15 math quintiles across the years, however in two of the remaining quintiles the coefficient is statistically significant and negative. Like salaries, this variable appears to be more important in quintiles with lower overall test performance.

Overall funding per student also has the expected positive impact on test scores. The coefficients of “perpupilfund” held fairly constant throughout all quintiles in all testing sections and years; always positive and always in the range of .0003 to .0017. The small coefficient values do not translate into a small effect; “perpupilfund” is in dollars meaning that the coefficient can be multiplied by 100 to find the effect of a \$100 increase in per pupil funding on student CSAP scores. Interestingly, at no point was “perpupilfund” significant in the highest quintile and its significance generally decreased across increasing quintiles. In other words, as school CSAP scores improved, the effect of per pupil funding on student performance decreased. Also notable, “perpupilfund” was largest and most significant for the Reading section of the CSAP test across all three school years, suggesting that the effect of per pupil funding on student performance is strongest in reading.

The R-squared values in Table 2 are low, but considering the multitude of factors that affect student performance, we satisfy ourselves with a meaningful, if not comprehensive, explanation of test scores that might aid policymakers. We present in Table 3 the results across all three CSAP test sections for the 2003-04 school year, for the reader’s investigation.

Table 3: Quantile regression results for 2003-2004 school year, all CSAP testing sections

	Mathematics (1580 observations)		Reading (1603 observations)		Writing (1603 observations)	
	coefficient	t-statistic	coefficient	t-statistic	coefficient	t-statistic
Bottom quintile						
Logadmin	17.79	2.97***	2.32	0.85	7.15	2.11**
Logteach	10.98	2.23**	9.03	5.58***	10.27	7.32***
Lunch	-36.80	-10.56***	-64.62	-28.36***	-60.96	-58.15
Stratio	0.10	1.96*	0.02	2.88***	0.02	1.29
Conduct	-19.05	-2.51**	-12.70	-2.73***	-4.91	-0.92
Localshare	13.25	2.15**	6.90	2.32**	9.86	2.51**
Perpupilfund	1.21x10 ⁻⁴	-0.19	6.01x10 ⁻⁴	1.51	5.41x10 ⁻⁴	2.09**
Constant	-271.04	-6.72***	-49.80	-1.84*	-134.02	-3.73***
Pseudo R ²		0.14		0.41		0.35
Second quintile						
Logadmin	12.83	2.35**	-0.27	-0.12	8.89	2.51
Logteach	10.55	3.05***	7.25	1.99**	6.98	2.01**
Lunch	-49.92	-21.21***	-64.01	-23.13***	-63.75	-30.11***
Stratio	0.05	1.62	0.02	1.75*	0.009	0.60
Conduct	-20.67	-3.51***	-11.96	-2.12**	-5.48	-1.18
Localshare	6.44	1.08	-0.28	-0.11	5.43	1.92*
Perpupilfund	4.32x10 ⁻⁴	0.68	6.01x10 ⁻⁴	2.42**	6.12x10 ⁻⁴	2.18**
Constant	-196.11	-4.88***	5.82	0.19	-109.60	-2.81***
Pseudo R ²		0.19		0.40		0.36
Third quintile						
Logadmin	10.71	2.65***	0.11	0.04	3.70	1.30
Logteach	10.58	2.85***	2.26	0.63	2.15	0.86
Lunch	-55.31	-29.31***	-61.98	-34.94***	-63.76	-29.50***
Stratio	0.06	1.73*	0.01	0.65	0.01	0.43
Conduct	-23.08	-3.84***	-8.59	-1.29	-5.05	-0.95
Localshare	3.25	0.71	-0.35	-0.17	4.12	1.48
Perpupilfund	7.02x10 ⁻⁴	1.16	7.00x10 ⁻⁴	2.30**	3.01x10 ⁻⁴	1.37
Constant	-163.41	-2.68***	56.84	2.14**	4.83	0.15
Pseudo R ²		0.22		0.37		0.36
Fourth quintile						
Logadmin	10.88	2.55**	0.39	0.14	2.89	1.27
Logteach	2.07	0.49	2.33	0.84	2.55	0.89
Lunch	-55.89	-17.39***	-57.10	-33.17***	-61.51	-26.76***
Stratio	0.04	0.52	0.03	1.25	0.01	0.62
Conduct	-14.55	-1.37	-0.16	-0.03	0.26	0.04
Localshare	3.56	0.77	-2.75	-1.34	-0.01	0
Perpupilfund	9.12x10 ⁻⁴	-1.68*	2.01x10 ⁻⁴	0.88	1.12x10 ⁻⁴	0.58

Constant	-55.87	-1.17		60.69	2.63***		18.17	0.51
Pseudo R ²		0.20			0.30			0.32
Top quintile								
Logadmin	9.44	2.39**		4.64	0.97		9.75	1.27
Logteach	-2.01	-0.36		-13.13	-1.76*		-6.44	-1.18
Lunch	-34.59	-5.39***		-30.87	-10.39***		-57.33	-8.83***
Stratio	2.01x10 ⁻³	-0.01		-0.04	-1.54		-0.04	-0.31
Conduct	-1.95	-0.14		-1.71	-0.25		-0.82	-0.11
Localshare	0.56	0.10		-5.24	-1.95*		-27.99	-4.10***
Perpupifund	4.12x10 ⁻⁴	0.72		2.21x10 ⁻³	2.77***		1.01x10 ⁻³	0.90
Constant	11.71	0.21		177.98	2.95***		60.31	0.53
Pseudo R ²		0.11			0.11			0.21

* = significant at 90%, ** = significant at 95%, *** = significant at 99% confidence intervals

The importance of using quintile regressions in this study instead of merely Ordinary Least Squared (OLS) regressions cannot be overstated. The five quintiles of results for every subject in every school year allowed for cross-group comparisons that led to more accurate, comprehensive observations of each variable. For instance, the observation that teachers' salaries have the largest effect on student performance in the worst performing schools (those in the 20th and 40th percentiles), was only made possible with quintile regression results, since OLS results would have averaged the effect across the whole dataset and excluded this quintile-specific observation.

In conclusion, the results show that administrator salaries had the largest effect on student scores in the mathematics section of the CSAP and had the largest overall effect on student performance during the 2003-2004 academic year. Further, a smaller effect on student performance than the percentage of students on free or reduced lunch in a school ("lunch"), per pupil funding ("perpupifund") and teacher salaries ("logteach"), but a greater effect than annual per pupil conduct violations ("conduct") and average student to teacher ratio ("stratio").

5. Conclusions

Administrator salaries were found to have a positive, causal relationship with student performance. This finding concurs with the literature on the subject which suggests that schools willing and able to attract better leadership talent with the lure of higher salaries are able to achieve better standardized test scores (Akiba and Reichardt, 2007). Most importantly, this result holds across years, across test subjects, and controls for the impact of other potentially confounding factors like teacher salaries and socioeconomic status of the school population.

The observed result that principal salaries have the largest effect on student scores in the math section of the CSAP (over reading or writing) stands as arguably the most interesting finding of this study. After an extensive search, no work related to education policy has found this subject-specific relationship with administrator or teacher salaries. We hypothesize that reading and writing skills are continually supplemented outside the classroom, both through the everyday life of children (like reading the menu at a restaurant) and by the conscious effort of parents (through bedtime stories, ample home libraries and forced letters or emails to relatives). Therefore environmental and familial factors may weigh heavily on a students' abilities to succeed at reading and writing, removing the school—and thus principal—from significantly determining outcomes on those sections of the CSAP. However, math—especially above simple addition, subtraction, multiplication and division—is a subject generally less practiced outside the classroom in the lives of 6 to 18 year olds, even in homes that insist on practicing other skills. Therefore students are on a more even educational playing field with math testing, making the influence of school factors more important in determining standardized scores

in the subject. Following this reasoning, administrator salaries (as well as other influencing variables within a school or school system) have a more considerable impact on students' math test scores than their reading or writing scores.

Further, if the rationale presented in the literature is adopted that higher salaried principals are more talented, then these principals could have strengthened their schools' math programs by increasing hours dedicated to math, insisting on higher standards for math teachers, etc. that led to higher math scores, explaining the positive relationship between principal salaries and CSAP math scores.

Similarly, teacher salaries were found to be positively correlated with student performance, as expected. Most interestingly, teacher salaries had the largest impact on student test scores in the lowest performing schools—a novel observation that deserves both consideration and further study. This result could be attributable to the fact that the mobility rate for teachers is highest in the worst schools, meaning that increases in teachers' pay could allow schools in this quintile to attract the best teachers available and willing to teach in these worst performing schools (Hanushek and Rivkin, 2007).

The fact that student to teacher ratios ("stratio") was found to have had little to no measurable effect on student performance contradicts previous literature on the subject. It is possible that the calculation to the ratio was too crude, and a more accurate calculation should have been used. Perhaps student to teacher ratios were too narrowly distributed to draw distinctions between their differences. In other words, if all of the state's K-12 public schools had similar student to teacher ratios, the differences would not be enough to compare CSAP results across varying levels. On the other hand, maybe student to teacher ratios do not, in fact, have a significant impact on student performance on CSAP

scores, due to the way the tests are written and administered or other unique factors of Colorado's education system and standardized tests.

The most relevant finding to policymakers—however disheartening it may be—is that the strongest indicator of performance on CSAP tests is completely outside of their control. The relative wealth of a school's student body (measured in this thesis by the percentage of students on free and reduced lunch in a school; "lunch") had a far larger effect on student performance than teacher salaries, average conduct violations, funding or even student to teacher ratios. This upholds the results of both Nakagawa's (2007) recent study on the determinants of CSAP scores and previous research on student performance on standardized tests, so this finding should not come as a surprise. Still, the fact that students' family wealth is far and away the most significant determinant of success on the CSAP tests should strongly factor into how the standardized tests are interpreted and applied to policy.

Policymakers should take particular note of the finding that teacher salaries had the largest effect on student test scores in the lowest performing schools. It is well known that the worst schools are often the toughest to staff, so recognizing the tremendous impact that teachers' salaries have in these schools should be of interest to policymakers at all levels. This holds especially true given the intense scrutiny that the lowest performing schools receive from local neighborhoods all the way up to the federal government.

The primary finding of this paper—that principal salaries do indeed have an effect on student performance, especially with CSAP math scores—should be evaluated and understood by state policymakers, School Boards, and superintendents alike. If

policymakers intend to make schools more accountable for the performance of the children within their classrooms, they must appreciate the impact of the people leading our schools. If more talented, effective people are hired and retained as K-12 school administrators, then they must be appropriately compensated—in a way and in a level we have yet to fully understand. Given the results of this study and the literature available about executive compensation in the private and non-profit sectors, policymakers should begin to make important, and difficult, choices about resource allocation.

As American national, state and local policymakers grapple with improving overall student achievement, much more academic research in education reform is needed to inform their actions. This study is simply one in the burgeoning field of educational leadership, a field which contributes to bettering our collective understanding of our education system and how it can be improved. This thesis should be viewed not as a conclusive study on the effect of principal compensation on standardized tests but rather as a spur for more research on the topic of K-12 school leadership.

A starting place for further research on this topic would be with a more rigorous analysis of the results of this thesis. The sheer number of results—nine regressions with five quintiles of results a piece, plus OLS results for every subject in every year—was daunting to interpret with constraints on time and econometric experience. Therefore, a more thorough review of the regression outputs, especially in regards to the variables other than administrator salaries is warranted.

Admittedly, this study has much room for improvement and future research in this area should be informed by the shortcomings of this thesis. For one, more variables could be included, however the analysis was limited to the available data. Other factors like

teacher quality (if somehow quantifiable) and time on task (possibly measured in numbers of class hours per year) should be included in future studies of the same topic. Similarly, it would be fascinating to evaluate the data along regional lines; does principal salary have a greater or lesser impact in rural school districts than in urban ones? Moreover, it would be interesting to view these results with information about the relative autonomy of principals. If there were some way to establish an index of the power and freedom of principals (for staffing and curricular decisions, etc.) and include that variable in the evaluation of the effect of their salaries on student performance, much more could be understood about the effectiveness of school leadership.

The area of research in principal compensation that is most compelling, however, is in pay-for-performance or similar incentive-based systems. Research comparing the differing effectiveness of different types of compensation packages for school leaders would be academically interesting and directly applicable to current policy debates. The challenge with this research is the relative lack of data, which may force it into the realm of controlled experiments or case studies.

6. References

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