Examining the relationship of states' human resources and capital investments on nonminority and minority graduation rates.

Marjee Chmiel

George Mason University

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ABSTRACT

Many public schools are facing budget restrictions due to large deficits faced by state and local governments. Cutting school budgets, however, is a complex affair as it may put students at risk for academic failure. Different student populations have historically been subject to greater risks of failure without adequate school support. The following study uses existing data sets regarding student graduation and dropout rates, as well as data regarding the average of capital and human resource expenses of all 50 states and Washington DC. The data have been provided by the National Assessment of Educational Progress. Our various analysis have found that overall instructional spending is not significantly related to overall percentages of student graduation rates. Some minority groups are more sensitive to student spending than others. However, states that invest in greater teacher-to-student ratios and teacher salary tend to have higher overall, high school graduation rates.

Introduction and background

As the US struggles with massive budget shortfalls at the state, local, and federal level, legislators and policy makers are looking everywhere to cut expenses and education is no exception (Resmann, 2009). Education is a considerable expense, especially at the state and local government level. While previous empirical investigations have demonstrated strong coorelations with school spending and student achievement (Sebold &b Dato 1981) scholars have found that in the past 20 years, changing demographics have brought with them vast changes to the financial obligations of school systems (Poterba, 1998) and that these changes were not consistent with previously established patterns.

The diverse nature of American students has made it difficult for policy makers, legislators, and even the courts to define what is equitable and sufficient for a just financial structure (Hoxby, 2002). Special education students, English Language Learners, at-risk students, and students from low socio-economic households have historically required greater financial resources , and these demographics are not evenly distributed throughout the country, however, all areas of the US are seeing an increase these student populations (Welner, & Chi, 2008). To be sure, in the US, when examining budget cuts in education, it is vital to know where these cuts can come from without compromising the changes for success of various populations that have been historically underserved by public education or may inherently require increased financial resources in order to provide legally required educational services (Campbell, & Ramey, 1995; Harry & Klingner, 2006). In what follows, we will examine the relationships among human resource and capital spending on the part of all 50 states and Washington D.C. to state graduation rates, with a particular eye towards differences among census designated racial and ethnic groups. In order to better understand where capital and human investments matter most for ensuring student graduation rates to remain high (and thus keeping the United States competitive in the

information economy), this study is needed in order to guide policy makers as they face difficult decisions regarding budget costs and staffing. In order to better understand the issues at stake, our research seeks to answer the following:

(1) Do the levels of spending, as measured in dollars pure pupil from a) local government, b) state government, and c) federal government, explain the overall percentage of high schools students dropping out?
(2) Do overall state graduation rates (as measured in percent of students graduating) vary depending on the level of teacher-to-student rations and the level of state spending on teacher salaries?
(3) Does a state's per pupil spending and graduation rate for nonminority students predict the graduation level (high and low) of minority students?
(4) Do state spending levels differ on graduation rates of racial and ethnic groups?

Methods

This study examines data and trends at the statewide level. It uses pre-existing data sets provided by the National Assessment of Educational Progress gathered via required annual documentation submitted by each state's office of education chiefs. The records used in this data are reflective of the most recently gathered data: that for the 2007-2008 school year. The population used for this study was the 50 US states and Washington D.C. The state of Delaware did not provide data, therefore the overall N= 50. All obtained data were for the state-wide level.

(1) Analytic tools used to understand the data were selected based upon their potential to answer the question at hand. The first question, "Do the levels of spending, as measured in

dollars pure pupil from a) local government, b) state government, and c) federal government, explain the overall percentage of high schools students dropping out?" Seeks an explanatory model and for this reason, we used a multiple regression. The next question, "Do overall state graduation rates (as measured in percent of students graduating) vary depending on the level of teacher-to-student rations and the level of state spending on teacher salaries?" employed a 2-way Analysis of Variance (ANOVA) test in order to determine whether there was statistically significant evidence that teachers' salary and teacher-to-student ratios were related to student graduation rates. Next, we used a binary logistic regression in order to determine whether a state's per pupil spending and graduation rate for nonminority students predict the graduation level (high and low) of minority students. For the final question, we used a planned comparison MANOVA to unpack whether state spending levels differ on graduation rates (as reported in % of students graduated) of racial and ethnic groups. The specific question breakdown contained within this larger inquiry is as follows:

(1) = Is the average effect for the top three state spending levels is different from the effect for the lowest state spending levels for each ethnicity (white, black, Hispanic, Native Alaskan/ Indian, and Asian)? (This is later referred to as $\Psi_{1)}$.

(2) = Is the average effect for the two highest spending rates different from that of the third highest spending rate for each ethnicity? (This is later referred to as $\Psi_{2)}$.

(3) Do the highest and second highest state spending rates differ on graduation rates for each ethnicity? (This is later referred to as $\Psi_{3)}$.

Results

For the question: Do the levels of spending, as measured in dollars pure pupil from a) local government, b) state government, and c) federal government, explain the overall percentage of high schools students dropping out, we used a multiple regression analysis. The ANOVA F test indicates that the prediction of state secondary student drop -out rates from per-pupil revenues at the state, local, and federal level is statistically significant, F (3,47) = 4.049, p = .012. Further R^2 = .205,which suggests that 20.5% of the variance in secondary school dropout rates can be explained by variability in per pupil revenue at state, local, and federal levels. The regression equation is:

Secondary school dropout rates = -6.26×10^{-5}(local revenue) + .002(federal revenue) + 0(state revenue)

Where every dollar of federal revenue increases state drop out percentage rates by .002 percentage points, every dollar of local revenue decreases dropout rates by -6.26×10^{-5} percentage points, and state revenue has no effect on secondary school dropout rates. Only federal revenue has a statistically significant (p = .001) unique contribution to state secondary school dropout rates by 19.89%. Thus, 19.89% of the variance in state secondary school dropout rates is uniquely accounted for by federal revenue. Results are published in Table 1.

A two-way Analysis of Variance was used to provide insight into the question: Do overall state graduation rates (as measured in percent of students graduating) vary depending on the level of teacher-to-student rations and the level of state spending on teacher salaries?

Descriptive statistics for this test are provided in Table 2. The Levene's test for equal variances shows that we have met the assumption for equivalent variances F(14,

35) = 1.64, p = .116. The results from the tests of between-subject effects indicate that while there is statistical significance for the main effect of states' level of teacher-to-student ratios $F(3,35) = 3.24$, $p = .035$, $p\eta^2 = .216$. The results also indicate a statistical significance for the main effect of the states' level of teacher salary, $F(3,35) = 5.40$, $p = .004$, $p\eta^2 = .317$. There is no statistical significance for the interaction effect, $F(8,35) = 1.24$, $p = .305$, $p\eta^2 = .221$. This analysis of variance can be found in Table 3. The results from the Tukey post hoc test for states' level of teacher-to-student rations show that states from the lowest level of teacher-to-student ratios (that is-more teachers per student) have higher graduation percentages than states with the states with the second greatest teacher-to-student rations by no less than 2.47% and no greater than 18.82%. The lowest level of teacher-to-student ratios outperformed the next lowest level of ratios by no less than 1.54% and no greater than 17.17%. Curiously, there was no difference between the lowest teacher-to-student ratio level and the highest teacher-to-student ratio level. Likewise, there was no difference among any other pairs of teacher-to-student ratio levels.

Regarding levels of spending on teachers' salary, states with the highest salary levels outperform those at the lowest salary levels in terms of percent students graduated by no less than 6.47% and no more than 22.44%. States with the highest salary levels outperform those at the second lowest salary levels by no less than 2.34% and no more than 18.00%. Finally, states at the highest salary levels outperform those at the second highest level by no less than 2.26% and no more than 17.92%. There are no differences among any of the other salary levels.

In order to determine the third question: Does a state's per pupil spending and graduation rate for nonminority students predict the graduation level (high and low) of minority students, a binary logistic regression was used.

The chi square test is statistically significant, $\chi^2(2) = 43.62$, $p<.001$, thus indicating that non-minority graduation rates and per-pupil spending do predict level of a states' minority dropout levels. There is also good data fit to the model, as indicated by the non-significant Hosmer-Lemeshow statistic, $\chi^2(8) = 4.56$, $p = .80$. The Nagerlkerke R^2 value is .783($R^2_N = .783$) thus indicating a relatively high explanatory effect in the prediction of states' minority drop out levels. Data from the classification table indicates a fair hit rate (60%). The sensitivity in this prediction high, 100% whereas the specificity is also high (100%). However, the false positive rate is 100%, whereas the false negative rate is 0%.

The results from the Wald test indicate statistical significance for the regression coefficients of non-minority graduation rates ($p = .001$) but not for per-pupil spending ($p=.602$).

The value of the odds ratios for non-minority graduation rates, Exp(B) = 1.509, indicates that the odds for a state to increase its minority graduate rate by a factor of (one and a half times) for a one unit increase of non-minority graduation rates. The confidence interval for this factor is at a modest 1.173 to 1.940 at the 95% level of confidence.

For the final question, we used a planned comparison MANOVA to unpack whether state spending levels differ on graduation rates (as reported in % of students

graduated) of racial and ethnic groups. The Box M's statistic was significant, M = 112.20, $\chi^2 = 90.32$, $p < .001$. , indicating the multivariate assumption of equal-covariance matrices is not met. We will proceed with caution with this analysis, as the MANOVA can be robust to violations of this assumption and this will be discussed further in the Limitations section of this paper.

For $\Psi_{1,}$ Is the average effect for the top three state spending levels is different from the effect for the lowest state spending levels for each ethnicity (white, black, Hispanic, Native Alaskan/ Indian, and Asian), the results for the Wilk's lambda test are not statistically significant, $\Lambda = .74$, $F(1,46) = 2.96$, $p = .064$. However, for $\Psi_{2,}$ Is the average effect for the two highest spending rates different from that of the third highest spending rate for each ethnicity, the results for the Wilk's lambda test are statistically significant, $\Lambda = .74$, $F(1,46) = 2.71$, $p = .028$, on the variables of race for Hispanic graduation rates $F(1,46) = 4.95$, $p = .031$, black graduation rates $F(1,46) = 8.88$, $p = .005$, and white graduation rates $F(1,46) = 4.67$, $p = .035$, barely significant for Native Alaskan/ Indian graduation rates $F(1,46) = 4.08$, $p = .049$ and not at all for Asian graduation rates $F(1,46) = 2.06$, $p = .16$.

Finally for $\Psi_{3,}$ do the highest and second highest state spending rates differ on graduation rates for each ethnicity, the Wilk's lambda is not statistically significant, $\Lambda = .78$, $F(1,46) = 2.41$, $p = .052$.

Limitations

This research study used only high-level, statewide data, making it impossible to capture nuances of regional differences across states. Since most schools are funded by a more local government, this provides only a cursory glimpse into how resources can affect student high school graduation rates, and a study examining differences among local governments can provide a more conclusive insight into the relationship between capital and human resources and graduation rates. Another important limitation in this particular study is the fact that in the MANOVA analysis, Box M statistic was significant, demonstrating that the multivariate assumption of equal-covariance matrices was not met. We proceeded with caution with this analysis, as the MANOVA can be robust to violations of this assumption. However, for future analysis, we recommend investigating alternative data transformatio0ns in order to ensure validity of results.

Discussion and Conclusions

Starting with the first question, we see that the only governmental level of funding predicting state graduation rates is at the federal level, and that to be sure, increased federal funding explains lower-overall graduation rates. The authors of this study hypothesize that this is due to the fact that increased federal funding may indicate an increased presence of Title 1 schools. Further analysis is required in order to better understand this strange phenomenon. Likewise, in order to get a more complete picture of how funding effects schools, this analysis should be broken down into analysis at the

local level, thus allowing us to better see whether within-state local funding holds explanatory power over district-level graduation rates.

In our second analysis, we saw that teacher-to-student rations and teacher salaries did vary along with increased graduation rates. This is interesting in light of our above analysis, which used blunt per-pupil spending and found little in terms of increased student graduation rates. This second study shows that they type of spending matters, and that maximizing teachers per pupil and increasing monetary compensation to teachers may benefit the state's overall graduation rates.

Our third analysis can the findings in our first analysis in that blunt, per-pupil spending did not predict the likelihood of all minority student graduation rates (black, Hispanic, and Native Alaskan/ Indian) but that the percentage of white graduates does successfully predict the graduation rate of minorities.

Finally, our analysis of state spending levels and individual ethnicity's graduation rates demonstrates that certain ethnic groups are more vulnerable to spending cuts, but only cuts at certain levels. The only significance our MANOVA found occurred when we looked at the top two spending levels compared to the next lowest level. Here we saw that the only group to not be affected were Asian students, with Native Alaskan/ Indian coming in at a nearly non-significant variance, while other ethnicities (white, black, and Hispanic) all saw variance among their graduation rates.

This preliminary research indicates that there is a good deal to learn by comparing spending across various community levels in the United States as governments struggle

with budgetary shortfalls while trying to maintain integrity in their public education offerings.

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Appendix

Table 1

Summary of Regression Analysis for Level of Government Spending Predicting States' High School Drop Out Rates by Percent

Variable	B	SE B	B	R^2
				.21
Local government	6.26×10^{-5}	.000	-.104	
State government	.000	.000	-.163	
Federal government	.002	.001	.453	

Table 2

Means and Standard Deviations for State Graduation Rates by Teacher-to-Student Ratio Levels and Teacher Salary Levels

	Teacher-student ratio level			Salary level			Total		
Level	N	M	SD	N	M	SD	N	M	SD
1	12	84.49	8.89	12	78.76	9.0	12	79.55	10.5
2	13	81.15	9.44	13	79.70	11.64	13	83.83	6.4
3	12	82.43	8.79	12	85.45	2.28	12	83.91	8.1
4	13	91.79	6.52	13	94.39	1.59	13	94.00	5.1

Table 3

Analysis of Variance for State High School Graduation Rates

Source	*df*	*F*	$p\eta^2$	*p*
Teacher-to-student ratio rates (T)	1	3.21	.216	.035
Salary rates(S)	3	5.407	.317	.004
T X S	8	1.23	.221	.305
S within group error	35	(52.60)		