California's Charter Schools: 2009 Update on Issues and Performance
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TECHNICAL APPENDIX

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Research methodology and analysis

In June 2009, EdSource published *California's Charter Schools: 2009 Update on Issues and Performance*, the fifth in a series of studies of the academic performance of California's charter schools. From publicly available data files from the California Department of Education, the study team constructed a database of 10,912 public schools that were open in the 2007–08 school year. There are 688 charter schools and 10,224 noncharters in the database.

Rules for including schools in the performance analyses

The study reflects multiple analyses of performance on a specific subset of schools. The schools included shared the following characteristics:

- The school was open in the 2007–08 school year;
- The school had 2008 Growth API information;
- The school had percent proficient reported in English/language arts and mathematics for 2007–08 AYP;
- The school reported a CST mean scale score in English language arts and mathematics in grade 4 in 2007–08 if it was an elementary school;
- The school reported a CST mean scale score in English language arts and mathematics in grade 7 in 2007–08 if it was a middle school;
- The school reported a CST mean scale score in English language arts in grade 10 in 2007–08 if it was a high school; and
- If the school was a high school, then it reported 10th grade CAHSEE scale scores in English language arts and mathematics in 2007–08.

Figure 1 below summarizes the reasons that schools were excluded from performance analyses.

Figure 1. Reasons that schools were excluded from the performance analyses.[1]

	Charter	Noncharter
Schools open in the 2007-08 school year	688	10,224
Lacked API	38	767
Lacked percent proficient in ELA or mathematics	18	326
Lacked CST mean scale score in ELA or mathematics	68	1,521
Lacked CAHSEE scale score in ELA or mathematics	3	11
Schools included in the performance analyses	561	7,599

Statistical approach to adjusting for differences in student demographics to find test-score differentials

To analyze the performance of the 8,160 schools that have the requisite data, the study team used stepwise regression. Regression techniques can help to overcome some of the challenges presented by the absence of an experimental design. In a researcher's ideal world, students and teachers would randomly choose schools. Indeed, in an ideal experiment, the researchers might randomly choose which schools would be able to operate as charter schools. Then researchers would study differences in performance, and assuming that the students in charter schools were of a sufficiently large number and were sufficiently representative of the state's student population, researchers could better attribute performance differences to charter status. Such features of experimental design are not possible in an examination of California's charter schools.[2]

This study uses regression to account and control for the effect of observable, measurable factors that are associated with academic performance. Each regression was run with data from a single year. Certain independent variables were included in all models and not subjected to stepwise selection (shown in bold below), while others were subjected to the stepwise selection process

[1] Any schools that have more than one of these reasons are reflected only once in the table, in whichever reason is closest to the top of the table.

[2] A few smaller studies have tracked the progress of students who either were admitted or denied admission to a charter school by a lottery. Because such studies compare students who are similar in most respects—including student and family motivation to *choose* a particular school—their claims about the role of the school in student outcomes are generally considered to be more valid (Betts & Hill, 2006).

(shown in order of when they entered the models, on average). In models where all variables entered, the regression equation was:

$$y = \beta_0 + \beta_1 \boldsymbol{CHARTER} + \beta_2 \boldsymbol{MIDDLE} + \beta_3 \boldsymbol{HIGH} + \beta_4 \boldsymbol{MIDCHART} + \beta_5 \boldsymbol{HIGHCHART} + \beta_6 \boldsymbol{SIZCHART} + \beta_7 \boldsymbol{SIZNCHART} + \beta_8 AVGED + \beta_9 SCHLMOB + \beta_{10} PCT\_AA + \beta_{11} PCT\_AS + \beta_{12} PCT\_EL + \beta_{13} MEALS + \beta_{14} PCT\_DI + \beta_{15} PCT\_FEMALE + \beta_{16} PCT\_AI + \beta_{17} PCT\_RFEP + \beta_{18} PCT\_PI + \beta_{19} PCT\_HI + \beta_{20} PCT\_FI + \varepsilon$$

where:

- y = academic performance measure, such as API, CAHSEE scale score, or CST scale score;
- *CHARTER* = 1 for all charter schools, 0 otherwise (other contrasts, such as CMO/EMO member versus nonmember, would also be substituted here);
- *MIDDLE* = 1 for middle schools, 0 otherwise;
- *HIGH* = 1 for high schools, 0 otherwise;
- *MIDCHART* = 1 for charter middle schools, 0 otherwise;
- *HIGHCHART* = 1 for charter high schools, 0 otherwise;
- *SIZCHART* = the natural logarithm of school enrollment for charter schools, standardized to have zero mean, 0 for noncharters;
- *SIZNCHART* = the natural logarithm of school enrollment for noncharter schools, standardized to have zero mean, 0 for charters;
- *AVGED* = average parent education, on the State's 1-5 scale (see "Handling of parent education" below);
- *SCHLMOB* = percentage of students counted as part of school enrollment in October 2007 CBEDS and continuously enrolled between that date and Spring 2008 testing;
- *PCT_AA* = percentage African American;
- *PCT_AS* = percentage Asian;
- *PCT_EL* = percentage of students who are designated as English Learners;
- *MEALS* = percentage of students who participate in the Free or Reduced Price Meal Program;
- *PCT_DI* = percentage of students with disabilities;
- *PCT_FEMALE* = percentage of female students;
- *PCT_AI* = percentage American Indian;
- *PCT_RFEP* = percentage of Reclassified Fluent-English-Proficient (RFEP) students;
- *PCT_PI* = percentage Pacific Islander;
- *PCT_HI* = percentage Hispanic or Latino;
- *PCT_FI* = percentage Filipino; and
- ε denotes the error term.

When the dependent variable is percent proficient for adequate yearly progress (AYP), regression is used with a transformed dependent variable: the logit, or log odds, of the percent proficient. Applying this transformation avoids the violation of linear regression assumptions that would otherwise ensue when using a proportion as the dependent variable. Effect size and statistical significance were calculated from the transformed variable, but effects were presented in the percent proficient metric.

Explanatory variables

The regression model (see above) consists of three sets of variables. The first set is made up of dummy variables that allow statements about differences in performance based on group membership. The variables *CHARTER, MIDDLE, HIGH, MIDCHART,* and *HIGHCHART* belong to this first set. The second set is the pair of variables built to control for size differences within the charter and noncharter sectors, *SIZCHART* and *SIZNCHART*. The third set is all those that are selected or not for the model based on stepwise regression. In this third set, four variables always emerge as having significant explanatory power: *AVGED, SCHLMOB, PCT_AA,* and *PCT_AS.* The rest of the third set, in order of when they entered the models, on average is: *PCT_EL, MEALS, PCT_DI, PCT_FEMALE, PCT_AI, PCT_RFEP, PCT_PI, PCT_HI,* and *PCT_FI.*

School size interaction term

This study controls for school size in a different way than the two prior EdSource studies did. In the two prior studies, school enrollment was part of the regression models, as the natural logarithm of enrollment was a control variable. Some readers of the prior studies suggested that "smallness" is part of the charter approach, and that controlling for school size in this way would eliminate part of the charter approach. To respond to such a concern, this year's methodology considers school size but does not eliminate any possible effect of "smallness" as part of the charter approach. Specifically, this year's models were run with a pair of interaction terms of charter status and the natural logarithm of enrollment. These variables were re-centered to have a mean of zero and are independent of charter status. This treatment allows for the statistical control of school size *within* the charter and noncharter sectors. Such analytic treatment incorporates any effect of differences in enrollment *within* charter and noncharter sectors while supporting the validity of the models' estimates.

Adjusting for scores from the prior year

In addition to the analyses reported, the team performed data runs (not shown) that indicate that when regressing current scores on prior year's score (and other variables), none of the indicator variables is significant. That is, these status or indicator variables (e.g., charter, CMO) are not statistically significant explainers of growth differences between different types of schools when the prior year's scores are included in the model.

Handling of parent education

State reports and data sets include parent education level both as an average and as a set of percentages of respondents in each of five categories. The categories are as follows: 1-Not High School Graduate, 2-High School Graduate, 3-Some College, 4-College Graduate, and 5-Graduate School. The average parent education level is the average of the five categories, weighted by the percentage of response in each category. Although such a calculation assumes linearity in the scale, the average parent education functions well, with a high correlation to all the dependent variables (e.g., 0.67–0.83 for API and AYP variables). Furthermore, as one independent variable, including it in regression models uses a single degree of freedom, in contrast with an approach

including percentages in the parent education categories, which would require four degrees of freedom. For these reasons, we prefer including the average parent education in the regression models.

Correlations among outcome measures

As the report indicates, the available outcome measures are strongly correlated. Figures 2.1 through 2.3 below display the (school-level) product-moment correlation coefficients for the outcome measures, by school type.

Figure 2.1. Correlations between Elementary School Measures.

	Base API	AYP English	AYP Math	CST English	CST Math
Base API	1.000				
AYP English	0.970	1.000			
AYP Math	0.952	0.904	1.000		
CST English	0.924	0.938	0.865	1.000	
CST Math	0.850	0.816	0.873	0.884	1.000

Figure 2.2. Correlations between Middle School Measures.

	Base API	AYP English	AYP Math	CST English	CST Math
Base API	1.000				
AYP English	0.976	1.000			
AYP Math	0.935	0.915	1.000		
CST English	0.966	0.977	0.903	1.000	
CST Math	0.900	0.876	0.917	0.896	1.000

Figure 2.3. Correlations between High School Measures.

	Base API	AYP English	AYP Math	CST English	CAHSEE English	CAHSEE Math
Base API	1.000					
AYP English	0.924	1.000				
AYP Math	0.914	0.921	1.000			
CST English	0.942	0.935	0.902	1.000		
CAHSEE English	0.925	0.956	0.897	0.956	1.000	
CAHSEE Math	0.930	0.924	0.963	0.940	0.942	1.000

Test score results not shown in the report

The results of some analyses are not displayed in the body of the report for several possible reasons: they do not differ substantially from the primary comparison; few statistically significant differences exist; or they are not as appropriate as the primary comparison, given the schools being compared. These omitted results are displayed below.

Within Charter Comparison—CMO Charters (broad definition) vs. Non-CMO Charters

(These tables relate to the tables on page 27 of the report.)

High Schools Only—Comparison Made with *All* Charters Included (ASAM and nonclassroom-based schools included)			
2008 Outcome Measure	**Average Score for Non-CMO charters** (171 schools)	**CMO Test Score Differential, After Adjusting for Student Demographics** (47 schools)	**Effect Size**
Growth 2008 API	663.1	+23.3 API points**	+0.22
English			
AYP English—percent proficient or above (CAHSEE, Grade 10)	44.7%	+5.5 percentage points**	+0.25
CAHSEE English, Grade 10—mean scale score	373.2	+5.5 scale score points***	+0.29
CST English, Grade 10—mean scale score	325.9	+10.4 scale score points***	+0.33
Math			
AYP Math—percent proficient or above (CAHSEE, Grade 10)	34.0%	+6.1 percentage points**	+0.29
CAHSEE Math, Grade 10—mean scale score	369.1	+3.2 scale score points not significant	+0.16
Strength of Findings			
Consistency: *High* – The effect sizes are all small and they all favor charter high schools that are part of CMOs.			

Middle Schools Only—Primary Comparison (excludes nonclassroom-based and ASAM schools)			
2008 Outcome Measure	**Average Score for NonCMO charters** (47 schools)	**CMO Test Score Differential, After Adjusting for Student Demographics** (30 schools)	**Effect Size**
Growth 2008 API	772.7	+12.4 API points not significant	+0.14
English			
AYP English, percent proficient or above (CST, all tested grades)	54.0%	+1.1 percentage points not significant	+0.06
CST English, Grade 7 – mean scale score	359.2	+3.5 scale score points not significant	+0.13
Math			
AYP Math—percent proficient or above (CST, all tested grades)	43.7%	+5.6 percentage points not significant	+0.28
CST Math, Grade 7 – mean scale score	342.9	+24.7 scale score points****	+0.75
Comparison Made with *All* Charter Middle Schools Included			
2008 Outcome Measure	**Average Score for Non-CMO charters** (49 schools)	**CMO Test Score Differential, After Adjusting for Student Demographics** (30 schools)	**Effect Size**
Growth 2008 API	773.9	+10.7 API points not significant	+0.12
English			
AYP English, percent proficient or above (CST, all tested grades)	54.4%	+1.5 percentage points not significant	+0.08
CST English, Grade 7 – mean scale score	359.6	+3.8 scale score points not significant	+0.14
Math			
AYP Math—percent proficient or above (CST, all tested grades)	43.4%	+4.8 percentage points not significant	+0.25
CST Math, Grade 7 – mean scale score	343.8	+24.4 scale score points****	+0.74
Strength of Findings (generalized for both comparisons)			
Consistency: *Moderate* – Although the results favor CMO charters, only one result is significant (CST Math, Grade 7).			

Elementary Schools Only—Comparison Made with *All* Charters Included (ASAM and Nonclassroom-based schools Included)			
2008 Outcome Measure	**Average Score for Non-CMO charters** (213 schools)	**CMO Test Score Differential, After Adjusting for Student Demographics** (51 schools)	**Effect Size**
Growth 2008 API	779.7	+20.5 API points**	+0.25
English			
AYP English, percent proficient or above (CST, all tested grades)	52.2%	+6.1 percentage points***	+0.34
CST English, Grade 4 – mean scale score	363.6	+1.6 scale score points not significant	+0.06
Math			
AYP Math—percent proficient or above (CST, all tested grades)	53.6%	+7.2 percentage points***	+0.40
CST Math, Grade 4 – mean scale score	367.4	+1.8 scale score points not significant	+0.05
Strength of Findings			
Consistency: *Moderate* –The performance differential on all measures favors charters that are part of CMOs, but the effect sizes vary substantially.			

CMO Charters (using broad definition) vs. Noncharters

(All comparisons displayed below *include* nonclassroom-based charters and all ASAM schools. The table below relates to the table on page 28 of the report.)

2008 Outcome Measure	Average Score for Noncharters	CMO Test Score Differential, After Adjusting for Student Demographics	Effect Size
High Schools Only (1,263 noncharters; 47 CMO charters)			
Growth 2008 API	683.7	+46.3 API points****	+0.42
English			
AYP English—percent proficient or above (CAHSEE, Grade 10)	48.7%	+7.2 percentage points****	+0.33
CAHSEE English, Grade 10—mean scale score	374.7	+8.1 scale score points****	+0.41
CST English, Grade 10—mean scale score	328.9	+14.6 scale score points****	+0.46
Math			
AYP Math—percent proficient or above (CAHSEE, Grade 10)	45.9%	+4.8 percentage points***	+0.21
CAHSEE Math, Grade 10—mean scale score	377.0	+5.4 scale score points****	+0.26
Middle Schools Only (1,249 noncharters; 30 CMO charters)			
Growth 2008 API	744.7	+45.6 API points****	+0.49
English			
AYP English—percent proficient or above (CST, all tested grades)	47.9%	+6.5 percentage points****	+0.36
CST English, Grade 7—mean scale score	348.3	+15.8 scale score points****	+0.56
Math			
AYP Math—percent proficient or above (CST, all tested grades)	42.0%	+7.9 percentage points****	+0.43
CST Math, Grade 7—mean scale score	339.2	+19.7 scale score points****	+0.69
Elementary Schools Only (5,087 noncharters; 51 CMO charters)			
Growth 2008 API	785.3	-12.8 API points**	-0.16
English			
AYP English—percent proficient or above (CST, all tested grades)	49.0%	+0.0 percentage points not significant	+0.00
CST English, Grade 4—mean scale score	358.1	-3.3 scale score points*	-0.12
Math			
AYP Math—percent proficient or above (CST, all tested grades)	58.0%	-2.6 percentage points not significant	-0.17
CST Math, Grade 4—mean scale score	374.2	-10.7 scale score points****	-0.33
Strength of Findings			
Consistency: *High* at the middle and high school levels. *Moderate* at the elementary level.			

Within Charter Comparison—CMO Charters (narrow definition) vs. Non-CMO Charters

(These tables relate to the table on page 29 of the report.)

High Schools Only (excludes nonclassroom-based charters and all ASAM schools)			
2008 Outcome Measure	**Average Score for Non-CMO Charters** (93 schools)	**CMO Test Score Differential, After Adjusting for Student Demographics** (30 schools)	**Effect Size**
Growth 2008 API	691.0	-1.1 API points not significant	-0.01
English			
AYP English—percent proficient or above (CAHSEE, Grade 10)	48.8%	+1.2 percentage points not significant	+0.05
CAHSEE English, Grade 10—mean scale score	377.6	+2.7 scale score points not significant	+0.14
CST English, Grade 10—mean scale score	335.0	+4.0 scale score points not significant	+0.13
Math			
AYP Math—percent proficient or above (CAHSEE, Grade 10)	41.5%	-0.7 percentage points not significant	-0.03
CAHSEE Math, Grade 10—mean scale score	376.5	-1.4 scale score points not significant	-0.07
Strength of Findings			
Consistency: *None* –The results on various measures conflict, and no results are statistically significant.			

Middle Schools Only (excludes nonclassroom-based charters and all ASAM schools)			
2008 Outcome Measure	**Average Score for Non-CMO Charters** (65 schools)	**CMO Test Score Differential, After Adjusting for Student Demographics** (12 schools)	**Effect Size**
Growth 2008 API	771.0	-10.2 API points not significant	-0.11
English			
AYP English—percent proficient or above (CST, all tested grades)	52.6%	-4.0 percentage points not significant	-0.21
CST English, Grade 7—mean scale score	358.4	-6.4 scale score points not significant	-0.24
Math			
AYP Math—percent proficient or above (CST, all tested grades)	44.0%	+3.0 percentage points not significant	+0.15
CST Math, Grade 7—mean scale score	345.5	-3.1 scale score points not significant	-0.10
Strength of Findings			
Consistency: *Low* – Most results favor non-CMO charters but no results are statistically significant.			