LAUSD School Facilities and Academic Performance

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Introduction

A good school facility supports the educational enterprise. Research has shown that clean air, good light, and a small, quiet, comfortable, and safe learning environment are important for academic achievement (see, for example, Cash 1993, Earthman and Lemasters 1996, Lemasters 1997, Lackney 1999, Cotton 2001, Schneider 2002). While factors such as student socioeconomic status and parental involvement are among the most important predictors of student academic performance, the condition, adequacy and management of a school building are directly under the control of the school district and state—hence improving school facilities offers a feasible opportunity for improving academic performance.

In this report we study the relationship between the extent to which schools in the Los Angeles Unified School District (LAUSD) comply with health and safety regulations and academic performance, as measured by California's API.[1]

Compliance Matters

In the Spring of 2003, the LAUSD completed an assessment of the health and safety compliance of its schools. It evaluated each school on 14 measures of compliance: accident prevention, asbestos management, fire/life safety, campus security, chemical safety, pest management, lead management, restroom facilities (e.g., mold, supplies, and ventilation), indoor environment (such as indoor air quality), maintenance and repair, safe school plan, emergency preparedness (including earthquake preparation), traffic and

[1] The API is a numeric index that ranges from a low of 200 to a high of 1000 and is based on California's Standardized Testing and Reporting (STAR) program. It is a weighted average of student performance as measured by the Stanford Achievement Test, Ninth Edition (Stanford 9) and the California Standards Tests (CSTs) in English-language arts, mathematics, and history-social science. More details appear in Appendix 1.

pedestrian safety, and science lab safety. These measures were combined to create an "Overall Compliance Rating" (OCR) for each school.

While the compliance measure does not necessarily reflect all of the many factors that affect the condition and the design of the school facility, a low OCR may signal a school that is in poor condition because of factors such as age, overcrowding, deferred maintenance, or poor initial design. A low OCR signals poor operating practices, e.g., failure to keep hazmat in approved storage cabinet, and, more generally, may identify a school that is poorly managed.

In this analysis, we measure the relationship between the facility OCR and the API, controlling for a variety of other factors known to affect academic performance, and we compare the effect of compliance to the effect of these other factors. There is a complex set of methods underlying the estimation procedure and we put the technical details in Appendix 2.[2]

We find that the compliance rating is linked to academic achievement. This means that just as various socioeconomic indicators predict academic performance, health and safety compliance (and what it indicates about the condition and management of the school facility) is also related to performance. The last two columns of Table 1 (below) are constructed from the results of a type of regression analysis (the full results are presented in the technical appendix). The next to last column shows the predicted effect on API of varying each factor in the model from the minimum to the maximum

[2] One particular issue we addressed is the possibility that variation in the OCR is a result of inspector biases rather than objective conditions in a school. This issue is compounded by the fact that inspectors are assigned to geographic clusters of schools and there is a distinct geographic pattern in the distribution of objective school conditions. Thus untangling the effects of inspector, geography, and compliance is difficult. As noted in the technical appendix, we address this problem by using a series of 10 indicator variables for the district in which the school is located, thus the relationship we report between OCR and API is "net" of geography and inspector.

observed value, holding the others constant. The final column shows the effect of a 1 standard deviation increase for each of the factors in the model on API.

The quality of the school as reflected in the OCR clearly matters. Our model predicts that controlling for the composition of the student body, the size of the school, and its level (high school, middle school, elementary school) changing a school from the worst condition, as measured by the facility OCR, to the best would, on average, lead to an increase of 36 points on the API. Alternatively, a one standard deviation increase in the OCR (about .46) predicts an API increase of 5.6 points. While much attention has been paid recently to creating small schools the effect of compliance is about the same as that of a reduction in enrollment: a 1-standard deviation reduction in enrollment (i.e., a decrease of 876 students) predicts a 6.1 point increase in API.

California sets growth targets for each school on the API. In 2002-03, the School Growth Target was calculated by taking five percent of the distance between a school's 2002 API (Base) and the statewide performance target of 800. Using this information, we can estimate how improving facilities management can affect schools as they try to reach their growth targets.

For a concrete example, consider Fremont Senior High School, which had a 2002 API of 452 and a facility OCR of .54. Fremont's growth target for the present year is 17.4 points. Our model suggests that one way Fremont could meet this target is by reforming its management practices in such a way that its OCR grew by about 1.4 points to 1.94 (which is just about the OCR of Aliso High School). Indeed, if Fremont managed its facilities to even reach the average level of compliance for high schools, according to our model, it could be about halfway toward meeting its growth target.

As another example, consider an elementary school that is close to the statewide target—Kester Avenue Elementary, which had an API of 790 and a OCR of 1.92. Kester's growth target is one API point,[3] and our model predicts that this could be attained by undertaking management reforms that increase its facilities OCR by only .04 to 1.96.

As both these examples indicate, reforms that lead to higher levels of compliance can be attained and can contribute toward meeting growth targets.[4] We recognize that improving facilities quality and management is a challenging task. However, while the other socioeconomic factors in the model clearly have a larger effect on API, they may be even less amenable to change by school or district administrators.

While we do not have the data to identify the specific mechanisms by which compliance is linked to educational outcomes, from existing research, we know that school buildings in poor shape lead to reduced learning. We also know that poorly managed schools lead to poor achievement. We believe that a low OCR identifies one or both conditions. In turn, our analysis suggests that the LAUSD should pay even more attention to the quality of its school facilities and their management as a means of increasing academic performance and achieving the growth in API set by the state of California.

[3] For any school with a 2002 API (Base) of 781 to 799, the annual growth target is one point.
[4] As in any statistical model, actual results for any specific school could be different due to uncertainty in the predictions. But these examples illustrate that improving facilities management can be an important tool for the LAUSD to pursue in this era of high stakes testing and increased accountability.

Table 1: Comparing the Effects of Several Factors on API[5]

	Minimum	*Maximum*	*Difference*	*Effect on API of Difference between Minimum/Maximum*	*Effect on API of 1 Standard Deviation Increase*
Facility indicators					
Facility OCR	0	3	3	36	5.6
Enrollment	68	5012	4944	-35	-6.1
Socio-economic indicators					
% Black	0	94.8	94.8	-190	-31.9
% Hispanic	2.8	99.9	97.1	-192	-54.0
% Free Lunch	3.6	100	96.4	-113	-26.9
Level of school					
Middle School	0	1		-70	
Secondary School	0	1		-84	

[5] Note: “Maximum” and “Minimum” refer to the observed values in the sample of 509 LAUSD schools. Effects are computed from the results of a heteroscedastic regression model of the mean and variance of API on the covariates. Details and full results of the model are included in the Technical Appendix.

Appendix 1: What is the Academic Performance Index?[6]

The Academic Performance Index (API) is the cornerstone of California's Public Schools Accountability Act of 1999 (PSAA). The purpose of the API is to measure the academic performance and growth of schools. It is a numeric index (or scale) that ranges from a low of 200 to a high of 1000. A school's score on the API is an indicator of a school's performance level. The statewide API performance target for all schools is 800. A school's growth is measured by how well it is moving toward or past that goal. A school's base year API is subtracted from its growth API to determine how much the school improved in a year.

Performance Indicators Included

The indicators included in the base API and corresponding growth API are basically the same, and the APIs are calculated in the same way, as reflected in an API reporting cycle. For the 2002-03 API reporting cycle, the indicators include the results of the following assessments:

- Standardized Testing and Reporting (STAR) program
    - Norm-referenced test (NRT) - all content areas

      2002 API Base: Stanford Achievement Test, Ninth Edition (Stanford 9)

      2003 API Growth: linked California Achievement Test, 6th Edition Survey (CAT/6)
    - California Standards Tests (CSTs) - English-language arts, mathematics, history-social science

[6] This is downloaded from Downloaded from http://www.cde.ca.gov/psaa/api/apidescription.htm

- California High School Exit Examination (CAHSEE)

Indicator Weights

For the 2002-03 API reporting cycle, the NRT in grades 2-8 received 20 percent of the weight in the API, and the CSTs received 80 percent of the weight. The NRT in grades 9-11 received 12 percent of the weight in the API, the CSTs received 73 percent of the weight, and the CAHSEE received 15 percent of the weight. The weighting demonstrates California's increased emphasis on tests that are closely aligned to state content standards (the CSTs and the CAHSEE) and reflects another major step towards the full alignment of standards, assessments, and accountability in California public schools. The indicator weights for the 2003-04 cycle will be adjusted to accommodate the addition of the CST science.

Calculation

To calculate the API, individual student scores from each indicator are combined into a single number to represent the performance of a school. For the NRT, the national percentile rank (NPR) for each student tested is used to make the calculation. For the CSTs, the standards-based performance level (Advanced, Proficient, Basic, Below Basic, or Far Below Basic) for each student tested is used. For the CAHSEE, a level of pass or not pass is used. The percentages of students scoring within each level are weighted and combined to produce a summary result for each content area. Summary results for content areas are then weighted and combined to produce a single number between 200 and 1000, which is the API for a school.

Appendix 2: Technical Details

The discussion in this report is derived from the following multiplicative heteroscedastic regression model (Harvey 1976; Greene 2000, 516-521):

$$
\begin{aligned}
y_i &\sim \text{Normal}\left(\mu_i, \sigma_i^2\right) \\
\mu_i &= \boldsymbol{\beta}'\mathbf{x_i} \\
\sigma_i^2 &= \exp\left(\boldsymbol{\gamma}'\mathbf{z_i}\right)
\end{aligned}
$$

where $\mathbf{x_i}$ and $\mathbf{z_i}$ are the observed data, and the vectors $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ are the estimated coefficients. We estimate the model using maximum likelihood, and assume that the predictors for the mean and the variance equations are the same. These predictors are:

- The facility OCR;
- The total enrollment of the school;
- The percentage of Black students;
- The percentage of Hispanic students;
- The percentage of students with free or reduced price lunch;
- Whether the school is a middle school;
- Whether the school is a secondary school;
- A series of 10 indicator variables for the district in which the school is located (to "identify" the model, District C is excluded), and;
- A constant term for each equation.

The results of the estimation are presented in Table A1, below. As the table shows, facility OCR and the demographic covariates are statistically significant in both the mean and variance equations, while the type of school indicators are significant only in the mean. The district indicator results are mixed. We reject the null hypothesis that the district indicators mean coefficients are jointly zero at the $p < .001$ level using a likelihood ratio test.

Table A1: Results of Multiplicative Heteroscedastic Regression Model

	Mean Coefficient (Standard Error)	Variance Coefficient (Standard Error)
Facility OCR	12.165 (4.465)***	.434 (.163)***
Enrollment	-.007 (.004)*	-.001 (.001)*
% Free Lunch	-1.176 (.166)***	-.023 (.006)***
% Black	-2.053 (.190)***	.024 (.007)***
% Hispanic	-1.981 (.162)***	.020 (.006)***
Middle school	-69.769 (6.115)***	-.359 (.250)
Secondary School	-84.151 (10.478)***	.041 (.391)
District I	-62.743 (9.708)***	-.738 (.374)**
District F	-11.641 (9.788)	.146 (.304)
District B	-23.634 (8.411)***	-.395(.283)
District K	10.730 (7.973)	-.503 (.273)*
District G	-31.558 (11.325)***	-.222 (.373)
District D	8.725 (7.522)	-1.352 (.277)***
District H	-27.415 (10.258)***	.042 (.325)
District J	-9.193 (9.765)	-.595 (.349)*
District A	-4.399 (7.783)	-.673 (.268)***
District E	4.068 (7.636)	-.526 (.271)*
Constant	900.634 (12.021)***	7.617 (.426)***

*** $p < .01$; ** $p < .05$; * $p < .10$, two-tailed
Dependent variable is 2002 School Academic Performance Index.
Number of Observations = 509.

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