The Impact of School Quality on Postsecondary Success: Evidence in the Era of Common Core

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HAMOC

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Motivation

**Schools Matter** (Cullen, Jacob, and Levitt, 2006; Deming, 2011; Dobbie and Fryer, 2013; Hastings and Weinstein, 2008; Abdulkadiroglu, Angrist, Dynarski, Kane, Pathak, 2011; Dobbie and Fryer (2013; 2017); Deming, Hastings, Kane, Staiger (2014); Angrist, Pathak, and Walters, 2013; Clark and Del Bono, 2016)
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Test-based school accountability

- Measure school performance
- Incentivize good school performance
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Test-based school accountability

- Measure school performance
- Incentivize good school performance

Usefulness of accountability rests on two key assumptions

- Schools affect test scores
- School contributions to test scores → socially important outcomes
This paper

- Estimate high school contributions to student outcomes using value-added models
  - Short-run: test scores used for accountability
  - “Long-run”: college enrollment

- Statewide data on CA public high school students linked to college outcomes

- Examine relationship between test score and college enrollment

- Does test score value-added "persist"?

- How much variation in college enrollment value-added is explained by test score value-added?
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- Examine relationship between test score and college enrollment VA
  - Does test score VA “persist”?  
  - How much variation in college enrollment VA is explained by test score VA
Prior literature

- **Value-added methods applied to teacher quality**
  (Rockoff, 2004; Rivkin, Hanushek and Kain, 2005; Kane and Staiger, 2008; Rothstein, 2010; Chetty, Friedman and Rockoff, 2014a,b; Chetty, Friedman and Rockoff, 2017; Rothstein, 2017)

- Effects of school accountability
  - Large literature on test score impacts and gaming (Figlio and Winicki (2005); Jacob (2005); Dee and Jacob (2010); Dee, Jacob and Schwartz (2013); Neal and Schazenbach (2010); Figlio and Rouse (2006); Reback (2008); Chiang (2009); and Rockoff and Turner (2010); Figlio and Loeb (2011))
  - Long-run effects (Deming, Cohodes, Jennings, Jencks (2016))

- Value-added methods applied to school effectiveness
  - Jennings, Deming, Jencks, Lopuch, Schueler (2015)
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  Key finding: Observational VA biased but highly correlated with lottery-based estimates
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High schools make significant contributions to test scores and college enrollment

- 1 s.d. of test score VA: $0.15\sigma$ student test scores
- 1 s.d. of college enrollment VA: 8.7 ppts 4-year enrollment
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Test score VA “persists”

- 1 s.d. increase in test score VA $\rightarrow$ 2.4 percentage point increase in 4 year college attendance
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- 1 s.d. increase in test score VA → 2.4 percentage point increase in 4 year college attendance

More than 2/3 of variation in college enrollment VA unrelated to test score VA
Data

Data sources

- CA Department of Education: statewide longitudinal high school records
  - 2015-2017 11th grade cohorts
- National Student Clearinghouse (NSC)
  - College enrollment records through fall 2017
  - We focus on enrollment in fall after “on time” HS graduation
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Sample

- Start with 1.4m students with valid 11th grade math and English scores
- Drop students if
  - Missing demographic characteristics
  - Missing pre-high school scores (8th grade ELA or 6th grade math)
  - Attending an “alternative” high school (e.g., online credit recovery school)
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- Final sample: ~900k students
### Panel A: 11th Grade Characteristics

<table>
<thead>
<tr>
<th></th>
<th>VA Sample</th>
<th></th>
<th>Dropped</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>11th Graders per School</td>
<td>473</td>
<td>[199]</td>
<td>393</td>
<td>[567]</td>
</tr>
<tr>
<td>Age in Years</td>
<td>16.7</td>
<td>[0.399]</td>
<td>17.0</td>
<td>[1.452]</td>
</tr>
<tr>
<td>Male</td>
<td>0.490</td>
<td></td>
<td>0.548</td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>0.523</td>
<td></td>
<td>0.520</td>
<td></td>
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<tr>
<td>White</td>
<td>0.255</td>
<td></td>
<td>0.259</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.141</td>
<td></td>
<td>0.101</td>
<td></td>
</tr>
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<td>Black or African American</td>
<td>0.051</td>
<td></td>
<td>0.083</td>
<td></td>
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<tr>
<td>Other Race</td>
<td>0.030</td>
<td></td>
<td>0.062</td>
<td></td>
</tr>
<tr>
<td>Economic Disadvantage</td>
<td>0.536</td>
<td></td>
<td>0.585</td>
<td></td>
</tr>
<tr>
<td>Limited English Proficiency Status</td>
<td>0.050</td>
<td></td>
<td>0.189</td>
<td></td>
</tr>
<tr>
<td>Disabled</td>
<td>0.030</td>
<td></td>
<td>0.200</td>
<td></td>
</tr>
<tr>
<td>ELA Z-Score</td>
<td>0.199</td>
<td>[0.893]</td>
<td>-0.454</td>
<td>[1.080]</td>
</tr>
<tr>
<td>Math Z-Score</td>
<td>0.183</td>
<td>[0.932]</td>
<td>-0.416</td>
<td>[1.025]</td>
</tr>
<tr>
<td>Prior ELA Z-Score</td>
<td>0.125</td>
<td>[0.955]</td>
<td>-0.343</td>
<td>[1.019]</td>
</tr>
<tr>
<td>Prior Math Z-Score</td>
<td>0.125</td>
<td>[0.978]</td>
<td>-0.376</td>
<td>[0.951]</td>
</tr>
</tbody>
</table>

Observations: 900,275 | 531,148
### Summary statistics

#### College enrollment rates

<table>
<thead>
<tr>
<th>Category</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolled at a Postsecondary Institution</td>
<td>0.715</td>
</tr>
<tr>
<td>Enrolled at a 2-Year College</td>
<td>0.385</td>
</tr>
<tr>
<td>Enrolled at a 4-Year University</td>
<td>0.329</td>
</tr>
<tr>
<td>Enrolled at a Public Institution</td>
<td>0.653</td>
</tr>
<tr>
<td>Enrolled at a Private Institution</td>
<td>0.062</td>
</tr>
<tr>
<td>Enrolled at a CA Institution</td>
<td>0.645</td>
</tr>
<tr>
<td>Enrolled at an Out-of-State Institution</td>
<td>0.069</td>
</tr>
</tbody>
</table>
Goal: isolate schools’ contribution to student outcomes
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Problem: hard to disentangle school effects from differences in student inputs
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Value-added models
“How do observed outcomes at a school compare to outcomes that would be expected given prior outcomes”
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Problem: hard to disentangle school effects from differences in student inputs

Value-added models
“How do observed outcomes at a school compare to outcomes that would be expected given prior outcomes”

We adapt Chetty, Friedman and Rockoff (2014) to estimate school value-added

1. Regress test scores on student inputs (demographics + prior test scores)
2. Compute average residuals by school-by-year
3. Instrument for year $t$ average residual with average residuals from other years
   “Value-added with drift”
$Y_{ist} = \phi_0 + \phi_1 X_{ist} + \beta S_{ist} + \eta W_{st} + \gamma t + \lambda_{st} + \xi_{st} + \epsilon_{ist}$

- $Y_{ist}$: outcome (e.g., test score) for student $i$ in school $s$ in year $t$
- $X_{ist}$: Demographic characteristics
- $S_{ist}$: Prior scores (cubic for 8th grade ELA and 6th grade math)
- $\xi_{st}$: “common shock”
- $W_{st}$: Number of students
- $\epsilon_{ist}$: Student residual
Estimating School Effectiveness with Value-Added

\[ Y_{ist} = \phi_0 + \phi_1 X_{ist} + \beta S_{ist} + \eta W_{st} + \gamma_t + \lambda_{st} + \xi_{st} + \epsilon_{ist} \]

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Average performance residuals (assuming $E(\epsilon_{ist}|s, t) = 0$)

$$u_{st} = \frac{1}{N_{st}} \sum_{i=1}^{N_{st}} [\lambda_{st} + \xi_{st} + \epsilon_{ist}]$$

$$= \lambda_{st} + \xi_{st}$$
Purging common shocks

Assumptions

- \( \text{cov}(\lambda_{st}, \lambda_{st'}) \neq 0 \) VA correlated across years
- \( \text{cov}(\xi_{st}, \xi_{st'}) = 0 \) Common shocks uncorrelated across years
- \( \text{cov}(\lambda_{st}, \xi_{st'}) = 0 \) Common shocks uncorrelated with VA

Instrument for year \( t \) with other years

- Estimate: \( u_{st} = \kappa u_{st'} + v_{st} \)
- Value added estimates: \( \hat{\lambda}_{st} = \hat{\kappa} \hat{u}_{st'} \)
Distribution of test score VA

11th Grade Test Score Value Added

Mean (Standard Deviation) = 0 (0.142)
Mean (Standard Deviation) = 0 (0.153)
Validity of VA estimates

- **Test 1: “Specification test”**
  - Is estimated VA associated with a one-for-one change in contemporaneous test scores?
  - Effectively checks whether information from other years successfully forecasts contemporaneous VA
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  - Effectively checks whether information from other years successfully forecasts contemporaneous VA

- **Test 2: Forecast bias**
  - Tests strong selection on observables assumption
  - Intuition: is student sorting related to scores not included as covariates in VA model?
Validity of test score VA

(a) ELA Specification Test

(b) ELA Forecast Bias Test

(c) Math Specification Test

(d) Math Forecast Bias Test
Distribution of college enrollment VA

Postsecondary Overall Value Added

Enroll Any Mean (Standard Deviation) = 0 (0.072)
Enroll 2-Year Mean (Standard Deviation) = 0 (0.077)
Enroll 4-Year Mean (Standard Deviation) = 0 (0.087)
Validity of college enrollment VA

(a) Postsecondary Enrollment Specification Test
(b) Postsecondary Enrollment Forecast Bias Test

(c) 2-Year Enrollment Specification Test
(d) 2-Year Enrollment Forecast Bias Test

(e) 4-Year Enrollment Specification Test
(f) 4-Year Enrollment Forecast Bias Test
Test score and college enrollment VA

(a) Enrolled VA

(b) Enrolled 2-Year VA

(c) Enrolled 4-Year VA
Persistence of test score VA to college enrollment

\[ Y_{ist} = \alpha_0 + \alpha_1 X_{ist} + \gamma_t + \rho \lambda_{st} + \beta_{st} + \theta_{st} + e_{ist} \]

\[ = \alpha_0 + \alpha_1 X_{ist} + \gamma_t + \pi_{st} + \theta_{st} + e_{ist} \]
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\[ = \alpha_0 + \alpha_1 X_{ist} + \gamma_t + \pi_{st} + \theta_{st} + e_{ist} \]

- \( \pi_{st} \): “total” college VA
- \( \rho \): persistence of test score VA to college enrollment
- \( \beta_{st} \): college VA orthogonal to test score VA
## Persistence of test score VA

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<thead>
<tr>
<th></th>
<th>Enrolled</th>
<th></th>
<th>Enrolled 2-Year</th>
<th></th>
<th>Enrolled 4-Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>ELA VA</td>
<td>0.201</td>
<td>0.031</td>
<td>0.027</td>
<td>0.060</td>
<td>0.174</td>
<td>-0.028</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.004)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Math VA</td>
<td>0.264</td>
<td>0.244</td>
<td>-0.009</td>
<td>-0.047</td>
<td>0.273</td>
<td>0.291</td>
</tr>
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<td></td>
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<td>(0.006)</td>
<td>(0.005)</td>
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</tr>
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Persistence of test score VA

Postsecondary Non–Test Score Value Added

Value Added

Density

Enroll Any
Enroll 2–Year
Enroll 4–Year

Enroll Any Mean (Standard Deviation) = 0 (0.061)
Enroll 2–Year Mean (Standard Deviation) = 0 (0.077)
Enroll 4–Year Mean (Standard Deviation) = 0 (0.072)

(d) Other (Non-Test Score) Factors, Controlling for ELA
Fraction of total college VA variance “explained” by test score VA persistence: $1 - \frac{\sigma_{\beta}^2}{\sigma_{\pi}^2}$
Fraction of total college VA variance “explained” by test score VA persistence: \(1 - \frac{\sigma^2_\beta}{\sigma^2_\pi}\)

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<tr>
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<th>1 - (\frac{\sigma^2_\beta}{\sigma^2_\pi})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any enrollment</td>
<td>0.28</td>
</tr>
<tr>
<td>2-year enrollment</td>
<td>(\sim 0)</td>
</tr>
<tr>
<td>4-year enrollment</td>
<td>0.31</td>
</tr>
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Conclusions and next steps

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- Schools have important effects on both test scores and college enrollment
- Test VA persists to college enrollment
- But most of college enrollment VA unrelated to test score VA

Next Steps

- More cohorts
- Explore mechanisms (e.g., funding, staffing, LCAP)
- Heterogeneity
- "Natural experiments" based on school closings
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