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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- Measure school performance
- Incentivize good school performance

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Usefulness of accountabiliy rests on two key assumptions

- Schools affect test scores
- School contributions to test scores $\rightarrow$ 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

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

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  - 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 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)

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- 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))
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  - Naven (2018)
  - Lottery vs. VA (Deming, 2014; Angrist, Hull, Pathak and Walters, 2017)
    - Key finding: Observational VA biased but highly correlated with lottery-based estimates

Preview of findings

- High schools make significant contributions to test scores and college enrollment
  - 1 s.d. of test score VA: 0.15σ student test scores
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- 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
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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)
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- Final sample: ~900k students

Summary statistics

	VA Sample		Dropped	
	Mean	Standard Deviation	Mean	Standard Deviation
Panel A: 11th Grade Characteristics				
11th Graders per School	473	[199]	393	[567]
Age in Years	16.7	[0.399]	17.0	[1.452]
Male	0.490		0.548	
Hispanic or Latino	0.523		0.520	
White	0.255		0.259	
Asian	0.141		0.101	
Black or African American	0.051		0.083	
Other Race	0.030		0.062	
Economic Disadvantage	0.536		0.585	
Limited English Proficiency Status	0.050		0.189	
Disabled	0.030		0.200	
ELA Z-Score	0.199	[0.893]	-0.454	[1.080]
Math Z-Score	0.183	[0.932]	-0.416	[1.025]
Prior ELA Z-Score	0.125	[0.955]	-0.343	[1.019]
Prior Math Z-Score	0.125	[0.978]	-0.376	[0.951]
Observations	900,275		531,148	

Summary statistics

College enrollment rates

Enrolled at a Postsecondary Institution	0.715
Enrolled at a 2-Year College	0.385
Enrolled at a 4-Year University	0.329
Enrolled at a Public Institution	0.653
Enrolled at a Private Institution	0.062
Enrolled at a CA Institution	0.645
Enrolled at an Out-of-State Institution	0.069

Estimating School Effectiveness with Value-Added

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- 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"

Estimating School Effectiveness with Value-Added

$$Y_{ist} = \phi_0 + \phi_1 X_{ist} + \beta S_{ist} + \eta W_{st} + \gamma_t + \underbrace{\lambda_{st} + \xi_{st} + \epsilon_{ist}}_{u_{ist}}$$

- 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)
- ξ_{st}: "common shock"
- W_{st}: Number of students
- ϵ_{ist} : Student residual

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

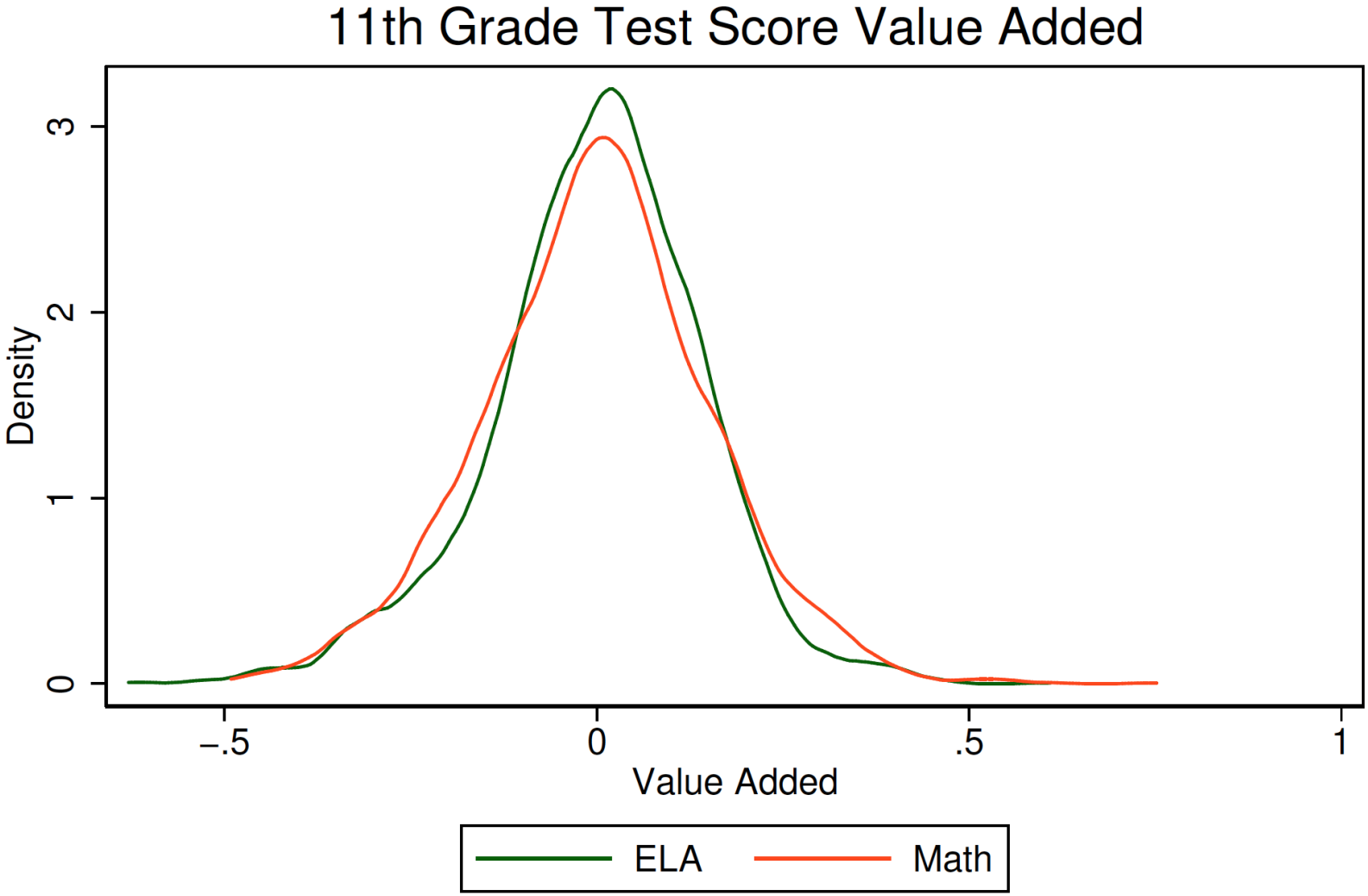
$$\begin{aligned} u_{st} &= \frac{1}{N_{st}} \sum_{i=1}^{N_{st}} [\lambda_{st} + \xi_{st} + \epsilon_{ist}] \\ &= \lambda_{st} + \xi_{st} \end{aligned}$$

Estimating School Effectiveness with Value-Added

Purging common shocks

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



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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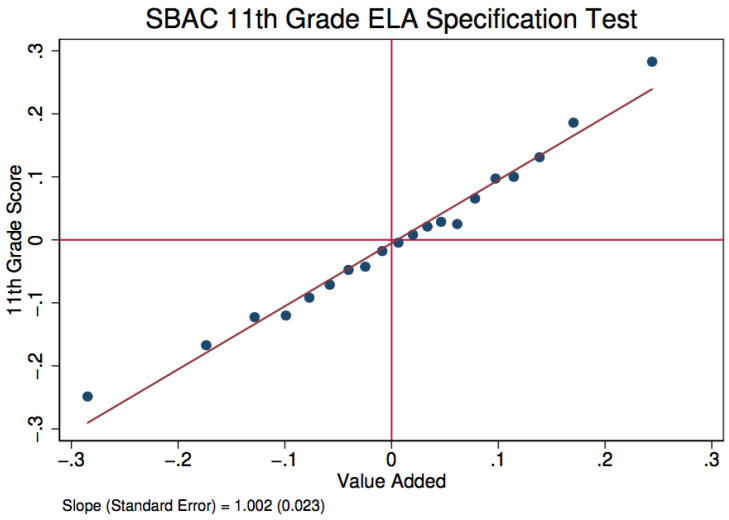
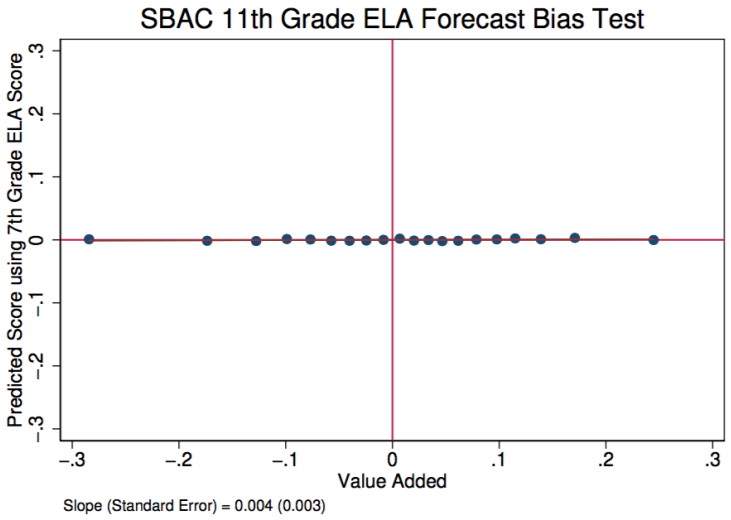
  - Effectively checks whether information from other years successfully forecasts contemporaneous VA
- Test 2: Forecast bias
  - Tests strong selection on observables assumption
  - Intuition: is student sorting related to scores not included as covariates in VA model?

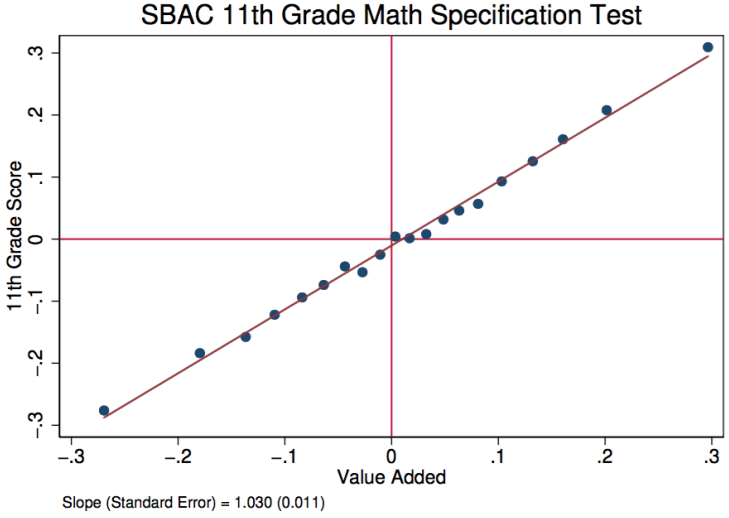
Validity of test score VA



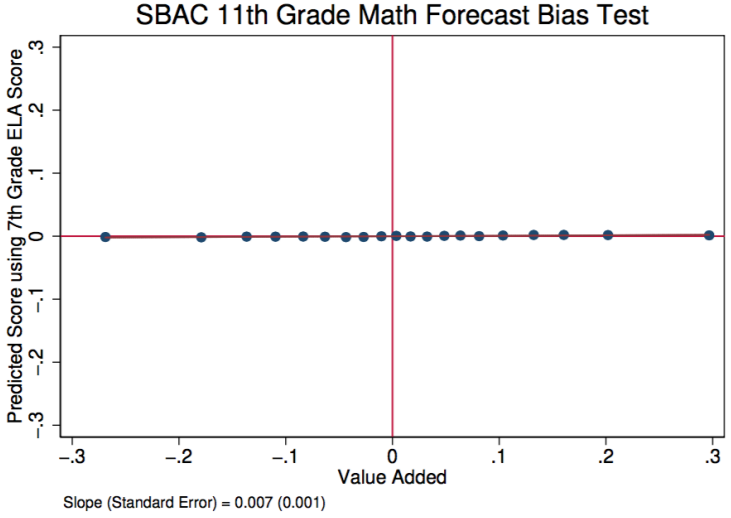
(a) ELA Specification Test



(b) ELA Forecast Bias Test

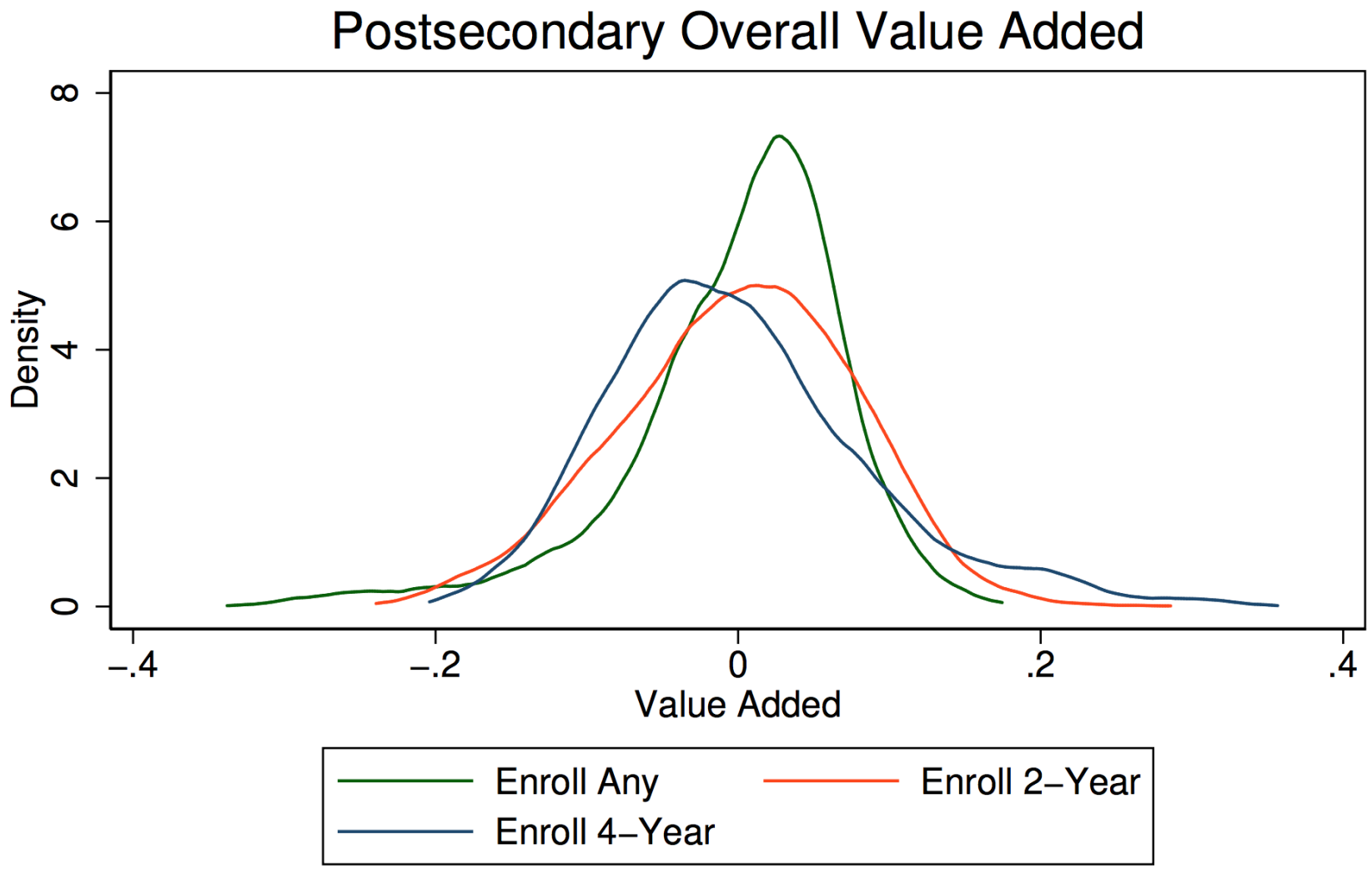


(c) Math Specification Test



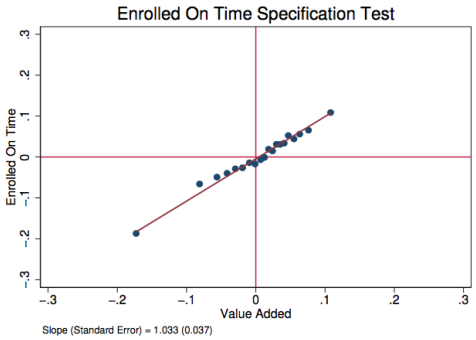
(d) Math Forecast Bias Test

Distribution of college enrollment VA

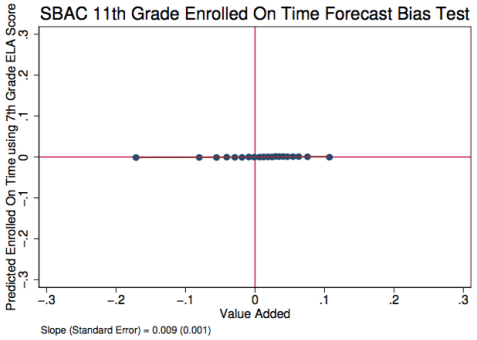


Enroll Any Mean (Standard Deviation) = 0 (0.072)
Enroll 2−Year Mean (Standard Deviation) = 0 (0.077)
Enroll 4−Year Mean (Standard Deviation) = 0 (0.087)

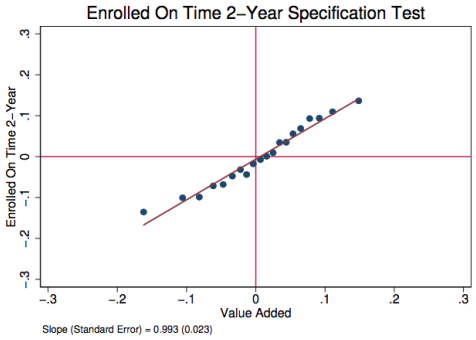
Validity of college enrollment VA



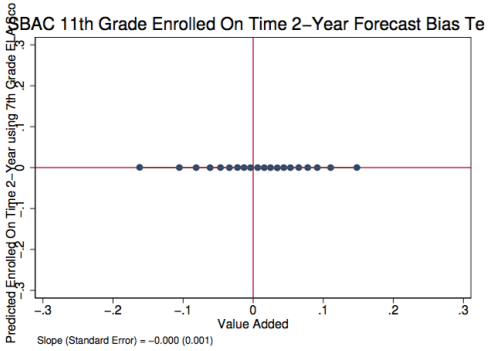
(a) Postsecondary Enrollment Specification Test



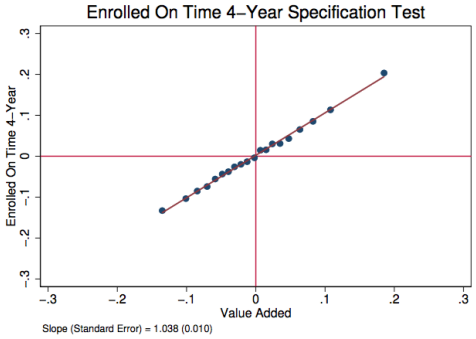
(b) Postsecondary Enrollment Forecast Bias Test



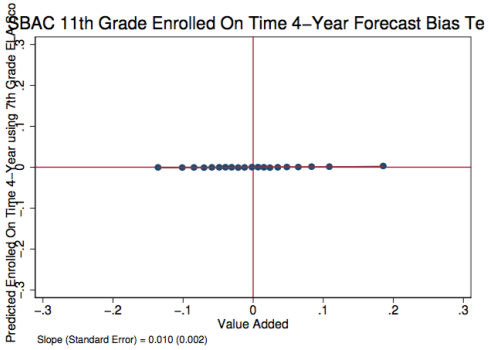
(c) 2-Year Enrollment Specification Test



(d) 2-Year Enrollment Forecast Bias Test

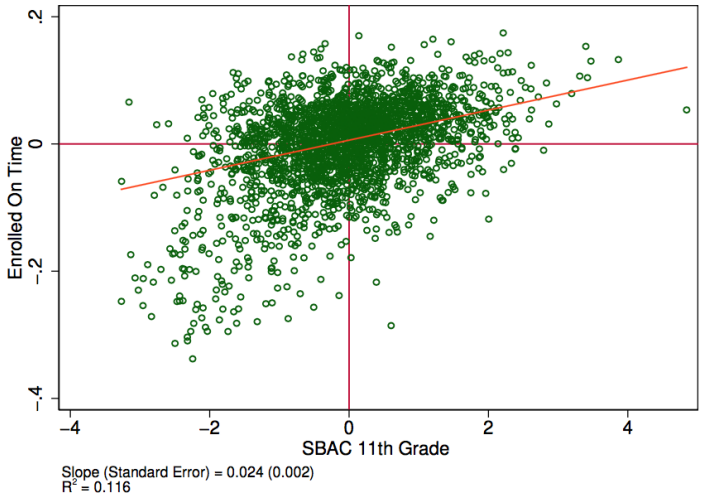


(e) 4-Year Enrollment Specification Test

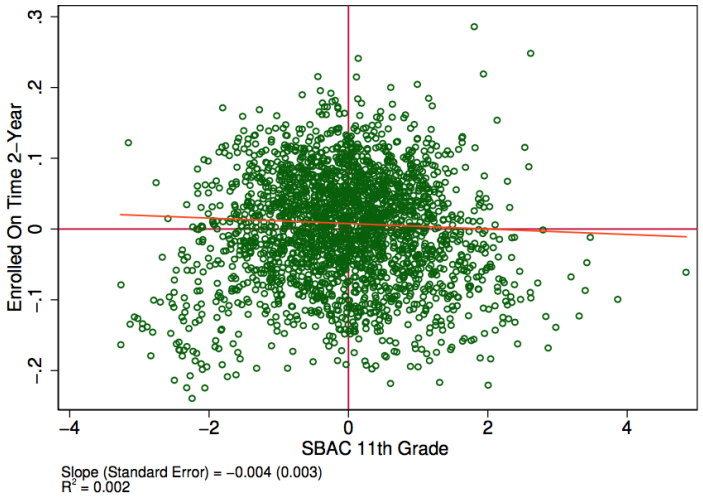


(f) 4-Year Enrollment Forecast Bias Test

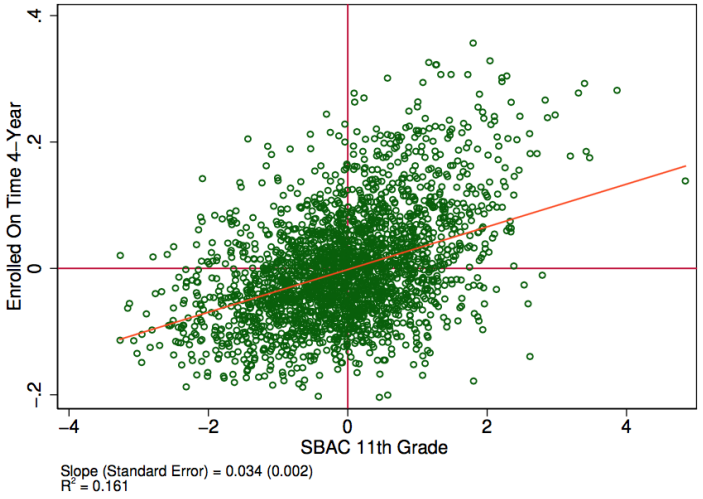
Test score and college enrollment VA



(a) Enrolled VA



(b) Enrolled 2-Year VA



(c) Enrolled 4-Year VA

Persistence of test score VA to college enrollment

$$
\begin{aligned}
Y_{ist} &= \alpha_0 + \alpha_1 X_{ist} + \gamma_t + \underbrace{\rho\lambda_{st} + \beta_{st} + \theta_{st} + e_{ist}}_{\nu_{ist}} \\
&= \alpha_0 + \alpha_1 X_{ist} + \gamma_t + \underbrace{\pi_{st} + \theta_{st} + e_{ist}}_{\nu_{ist}}
\end{aligned}
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\end{aligned}
$$

- π_{st}: "total" college VA
- ρ: persistence of test score VA to college enrollment
- β_{st}: college VA orthogonal to test score VA

Persistence of test score VA

	Enrolled			Enrolled 2-Year			Enrolled 4-Year		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ELA VA	0.201		0.031	0.027		0.060	0.174		-0.028
	(0.004)		(0.006)	(0.005)		(0.006)	(0.004)		(0.006)
Math VA		0.264	0.244		-0.009	-0.047		0.273	0.291
		(0.004)	(0.006)		(0.005)	(0.006)		(0.004)	(0.005)

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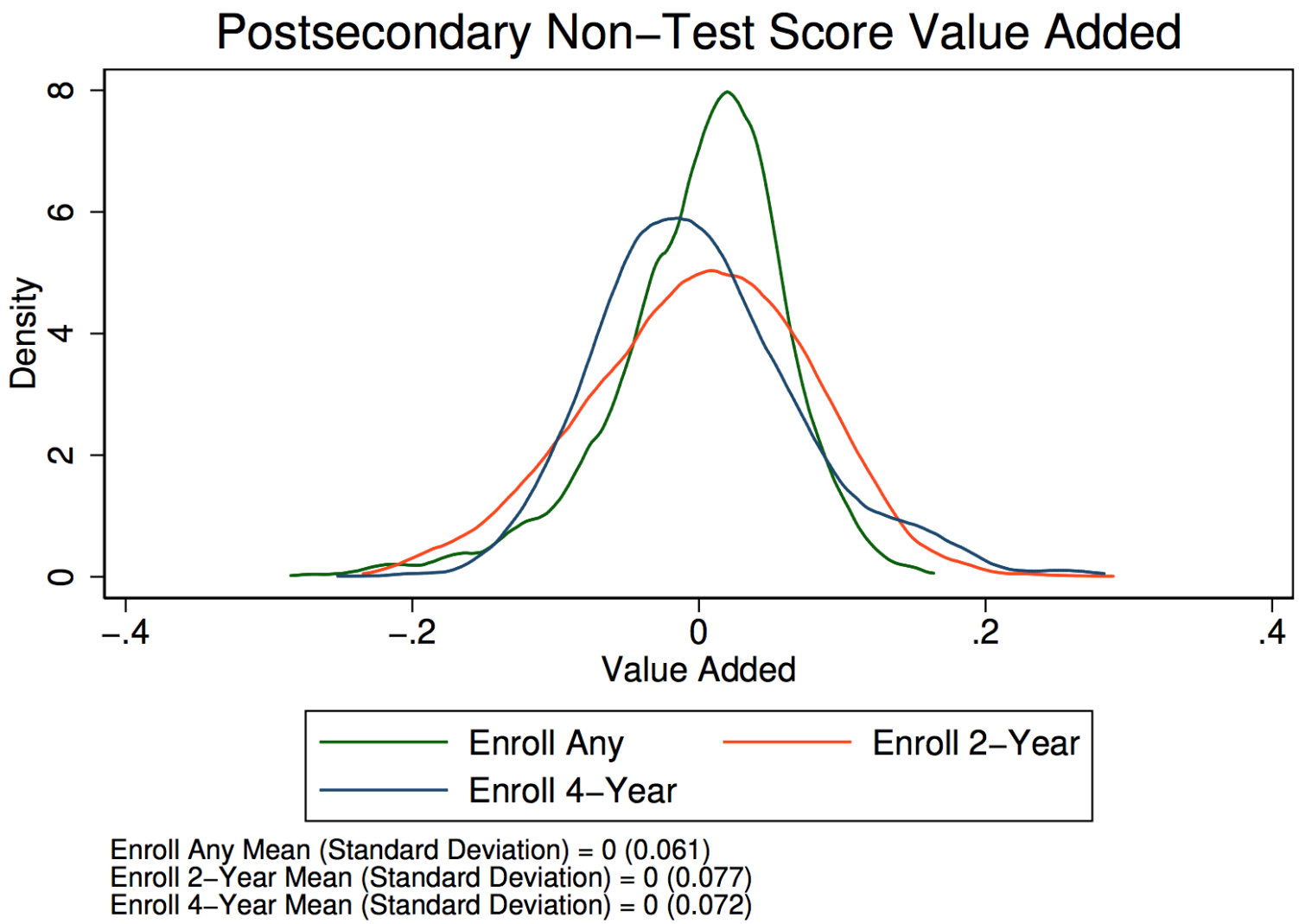

(d) Other (Non-Test Score) Factors, Controlling for ELA

Share of long run VA

Fraction of total college VA variance "explained" by test score VA persistence: $1 - \frac{\sigma_\beta^2}{\sigma_\pi^2}$

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Outcome	$1 - \frac{\sigma_\beta^2}{\sigma_\pi^2}$
Any enrollment	0.28
2-year enrollment	~ 0
4-year enrollment	0.31

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Next Steps

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