Outsourcing Service Delivery: Experimental Evidence from Liberia

Mauricio Romero (ITAM)
Justin Sandefur (CGD)
Wayne Sandholtz (UCSD)

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NBER

The logic of PPPs

- Overcome **efficiency-equity trade-off**:
  - Efficiency: Private schools are on average better managed than public schools (N. Bloom, Lemos, Sadun, & Van Reenen, 2015; Muralidharan & Sundararaman, 2015)
  - Equity: Fee-charging private schools may increase inequality and sorting (Hsieh & Urquiola, 2006; Lucas & Mbiti, 2012; Zhang, 2014)
- Overcome **financing constraints**:
  - Governments enter PPPs in large-part to raise capital (World Bank, 2015)
  - NB: impacts necessarily include resource and efficiency effects

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- Overcome **financing constraints**:
  - Governments enter PPPs in large-part to raise capital (World Bank, 2015)
  - NB: impacts necessarily include resource and efficiency effects
- Contractors have incentives to cut quality on non-contracted/non-monitored processes/outcomes (Hart et al., 1997)

This paper: RCT across 185 schools in Liberia

- Outsource *management* of public schools to private providers
  - 7% of public primary schools and 12% of students
  - Randomly assign treatment at the school level (matched-pairs)
  - Sample students from enrollment records prior to treatment

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- Outsource *management* of public schools to private providers
  - 7% of public primary schools and 12% of students
  - Randomly assign treatment at the school level (matched-pairs)
  - Sample students from enrollment records prior to treatment
- Treatment increases test scores by $.18\sigma$ after 1 year
- Heterogeneity by provider: Highest=0.36σ, lowest=0
- Contracts matter
  - Removal of students from over-subscribed schools
  - Dismissal of under-performing teachers

Relation to the Literature

1. **Contracting out public services**
   - Theory: Hart et al. (1997)
   - Empirically: Water (Galiani, Gertler, & Schargrodsky, 2005), food distribution (Banerjee, Hanna, Kyle, Olken, & Sumarto, 2019), health (Loevinsohn & Harding, 2005; E. Bloom et al., 2007), education (Aslam, Rawal, & Saeed, 2017)

   $\Rightarrow$ **Contracting out management of public schools**

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2. **Charter schools**
   - Charter take-overs: Abdulkadiroğlu et. al. (16)
   - Lotteries to overcome endogeneity: Chabrier et. al. (16)
   - Truncated distribution of estimated effects: Tuttle et. al. (12)

   $\Rightarrow$ **Treatment effects: Across all schools and providers**

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   $\Rightarrow$ **Treatment effects: Across all schools and providers**

3. **RCTs**
   - Joint impact of "treatment" *and* the implementing partner

   $\Rightarrow$ **Same program, same country, different implementers**

Outsourcing Service Delivery

Introduction

Context: Low learning & a weak state

The experiment: Private management of public schools

Results

Final thoughts

Outsourcing Service Delivery

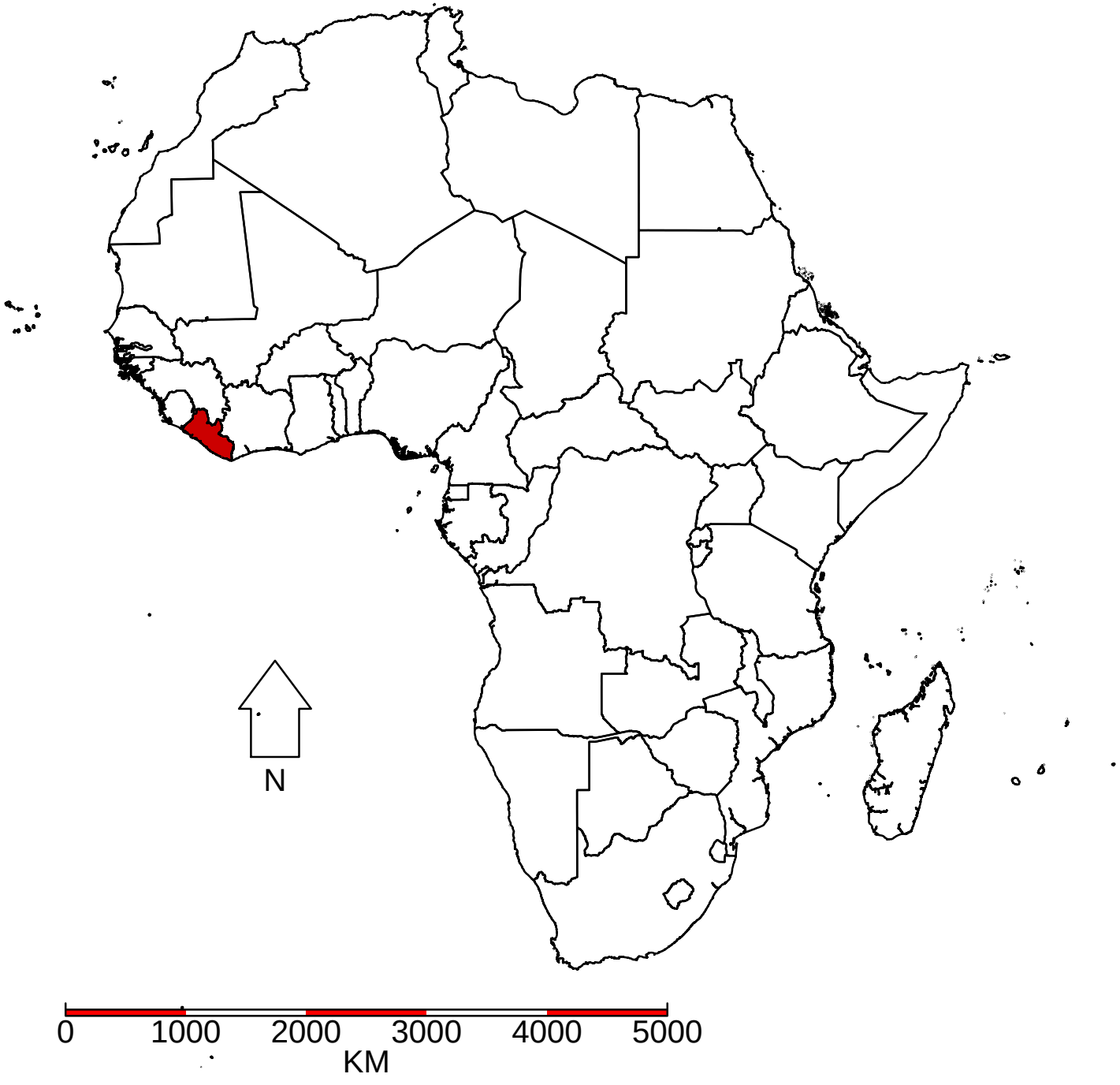
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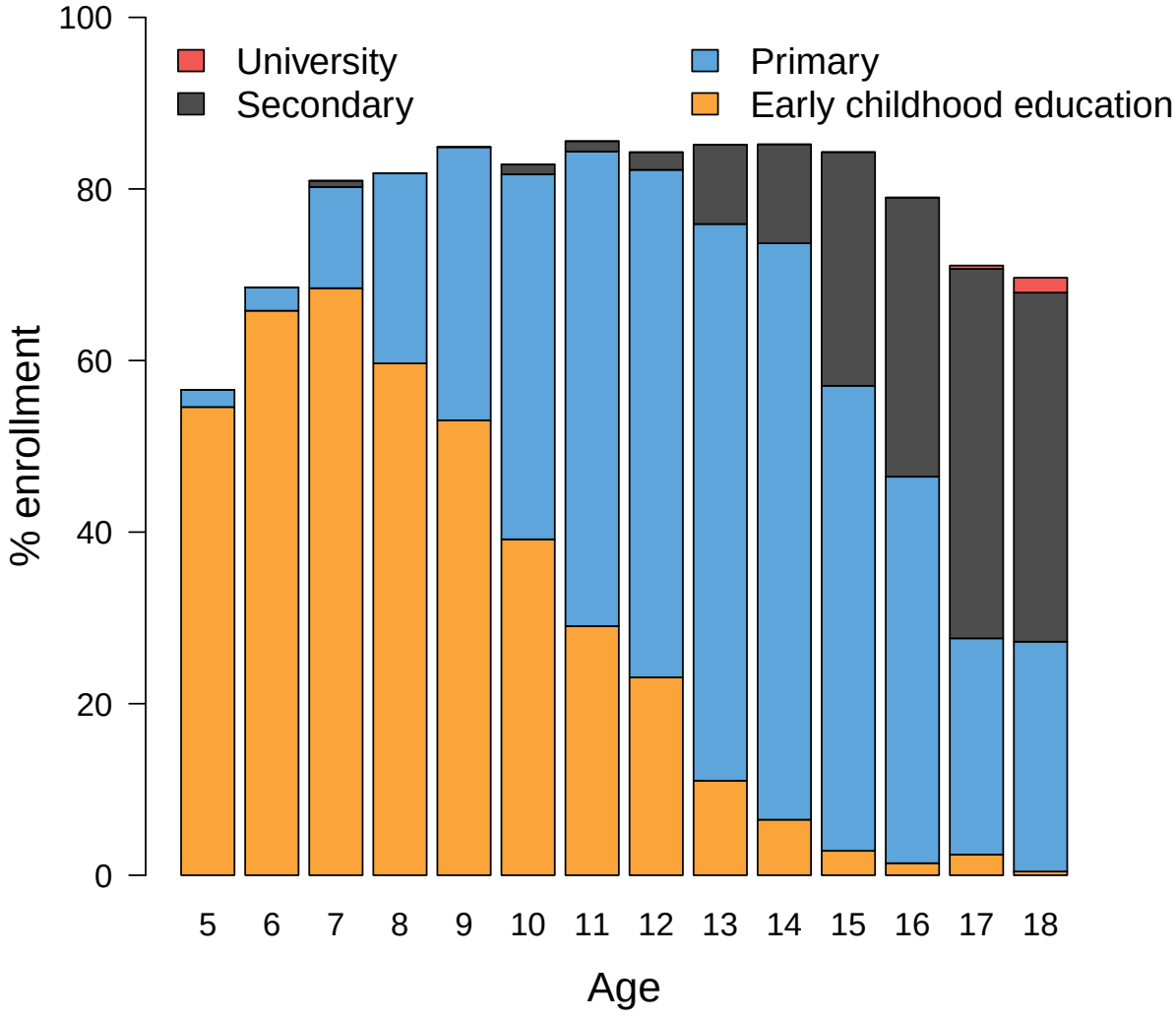
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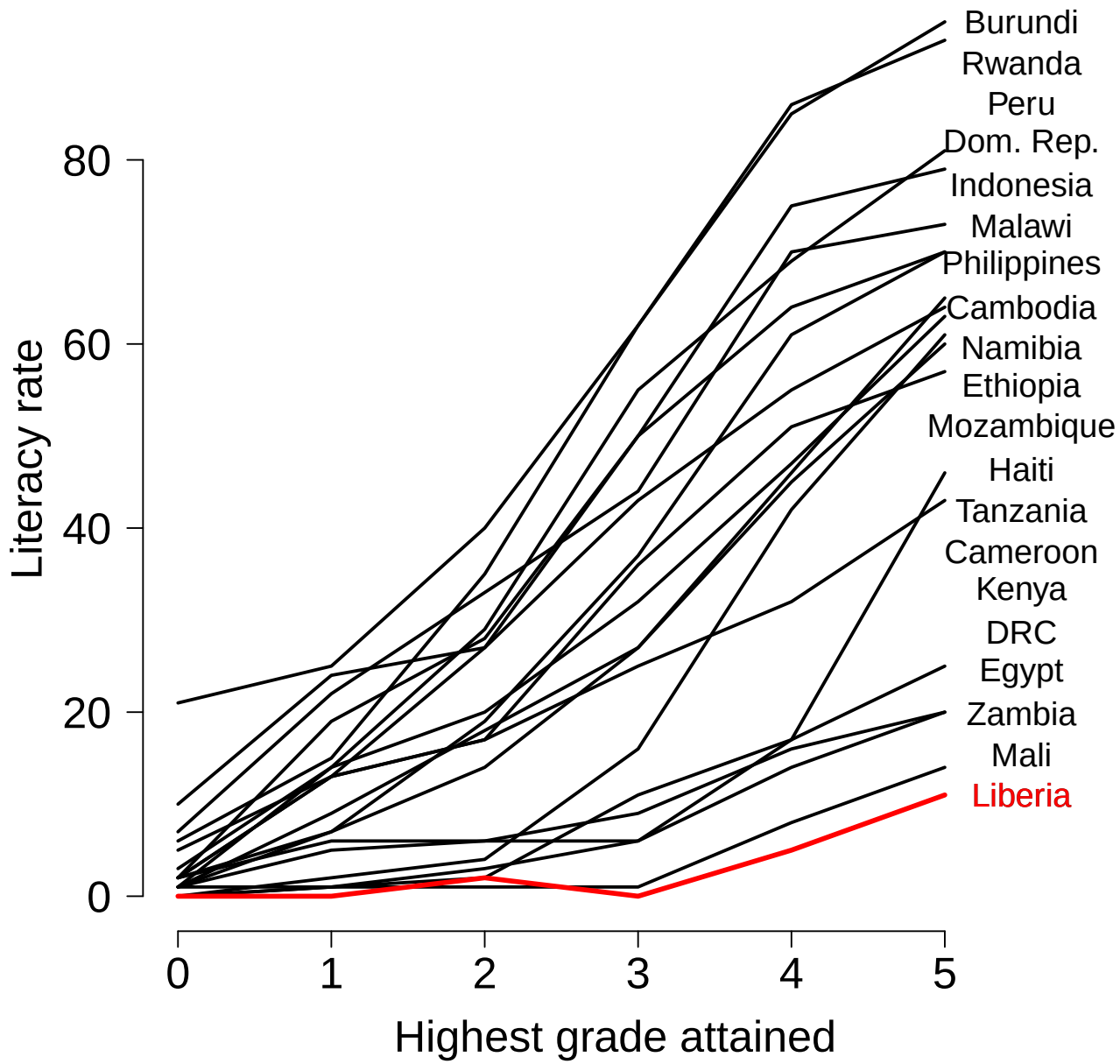

N
0
1000
2000
3000
4000
5000
KM

Low enrollment and backlog of overage children



Note: Based on 2014 Household Income and Expenditures Survey.

Schooling $\neq$ learning



Source: Oye, Pritchett, and Sandefur (2016)

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Liberia is outsourcing education. Can it work?



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A war-scorched state where almost nothing works tries charter schools



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The Opinion Pages

Liberia, Desperate to Educate, Turns to Charter Schools

Tina Rosenberg
FIXES JUNE 14, 2016

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What are "Partnership Schools for Liberia"?

- 93 schools
- free
- non-selective
- staffed by teachers on government payroll
- and managed by 8 private contractors
- with a \$50 per pupil subsidy (+ fundraising)

▸ More details ▸ What do contractors do? ▸ How does this compare to other PPPs?

8 Private providers

- 5 are nonprofit
- 3 are local
- 6 were contracted through competitive tender

▸ More details ▸ What do contractors do? ▸ How does this compare to other PPPs?

Experimental details

- Endogenous participation in lotteries $\not\rightarrow$ population TE
- Uncover implementer-specific treatment effects
- Endogenous sorting of students (supply or demand driven)

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- Endogenous participation in lotteries $\not\rightarrow$ population TE
- Uncover implementer-specific treatment effects
  - Endogenous sorting of implementers into regions
  - Randomize within the pairs that each implementer accepted
- Endogenous sorting of students (supply or demand driven)

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Experimental details

- Endogenous participation in lotteries $\not\rightarrow$ population TE
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- Endogenous sorting of students (supply or demand driven)
  - Sample students from enrollment records prior to treatment
  - Track them and assign to original schools for analysis (ITT)

Data

- **School:** Facilities, expenditure, management.
- **Teachers:** Socio-demographic, qualifications/experience, knowledge test.
- **Classroom observations:** Stallings
- **Students:** 20 students across all grades (2015/2016 log)
- **Households:** Survey 7-10 HH (only follow ups)

Time-invariant characteristics are balanced and attrition is low

- Time-invariant school characteristics are balanced
- Time-invariant student characteristics are balanced
- Attrition is below 4% and balanced

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Empirical specification

$$Y_{isp} = \alpha_p + \beta T_s + \varepsilon_{isp} \quad (1)$$

$$Y_{isp} = \alpha_p + \beta T_s + \gamma X_i + \delta Z_s + \varepsilon_{isp} \quad (2)$$

- Y_{isp}: Outcome for student i in school s and pair p
- α_p: Matched-pair fixed effects (stratification dummies)
- T_s: Treatment dummy
- X_i: Student level controls
- Z_s: School level controls show me
- Clustered *s.e.* at the school-level

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Test design

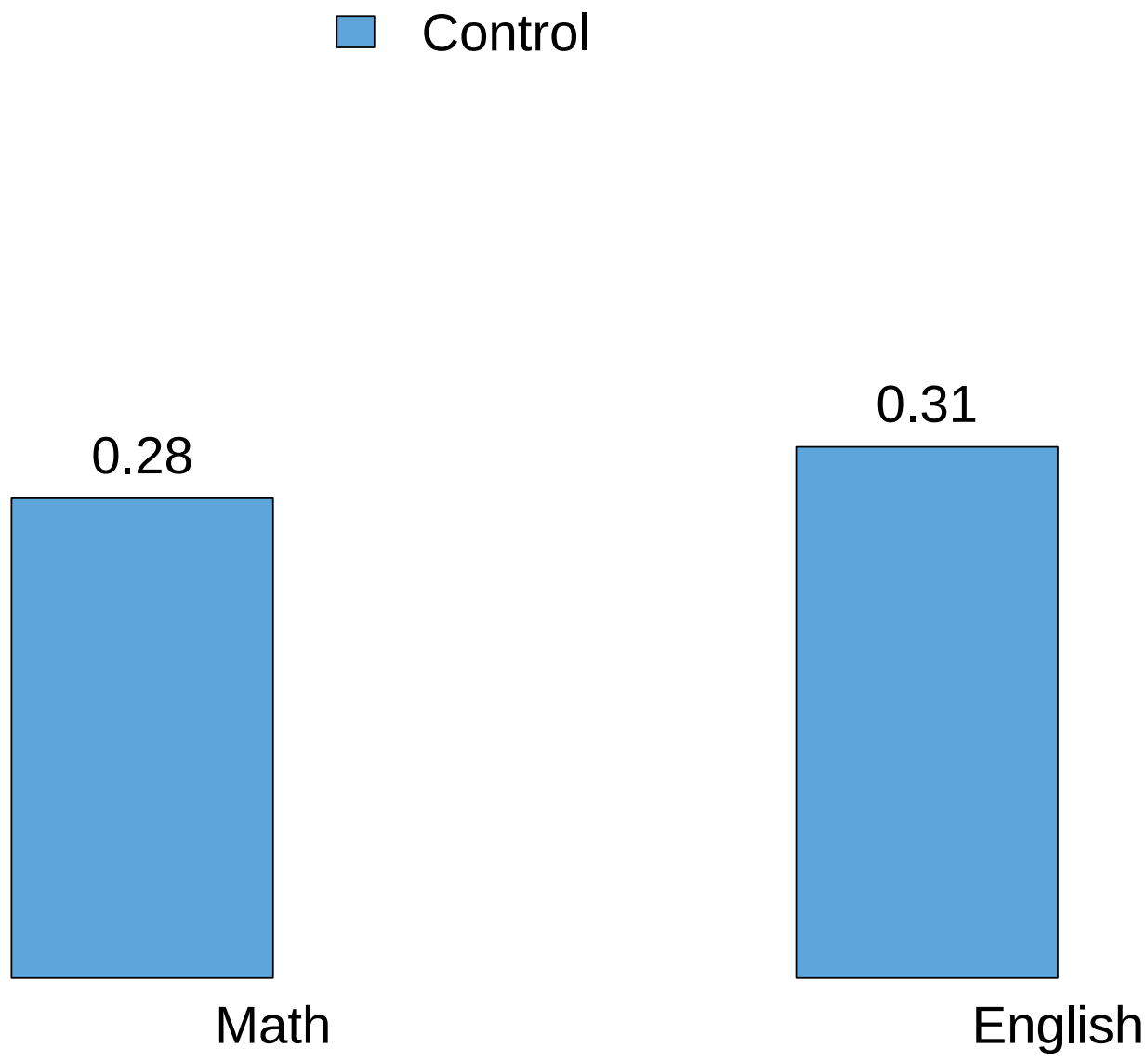
- One-on-one tests
  - Literacy cannot be assumed at any grade level
  - Prevents cheating
- Single adaptive test for all students
  - Capture a wide range of abilities
  - Comparability across grades
- Item response theory (IRT) to estimate student's ability
  - Widely used and "best practice" (GRE, SAT, PISA, TIMSS)
  - Simultaneously estimate the test taker's ability and the difficulty of the questions
  - Comparability across students (if overlap is imperfect)
- Normalize the scores with respect to the control group

Test scores increased by .18σ

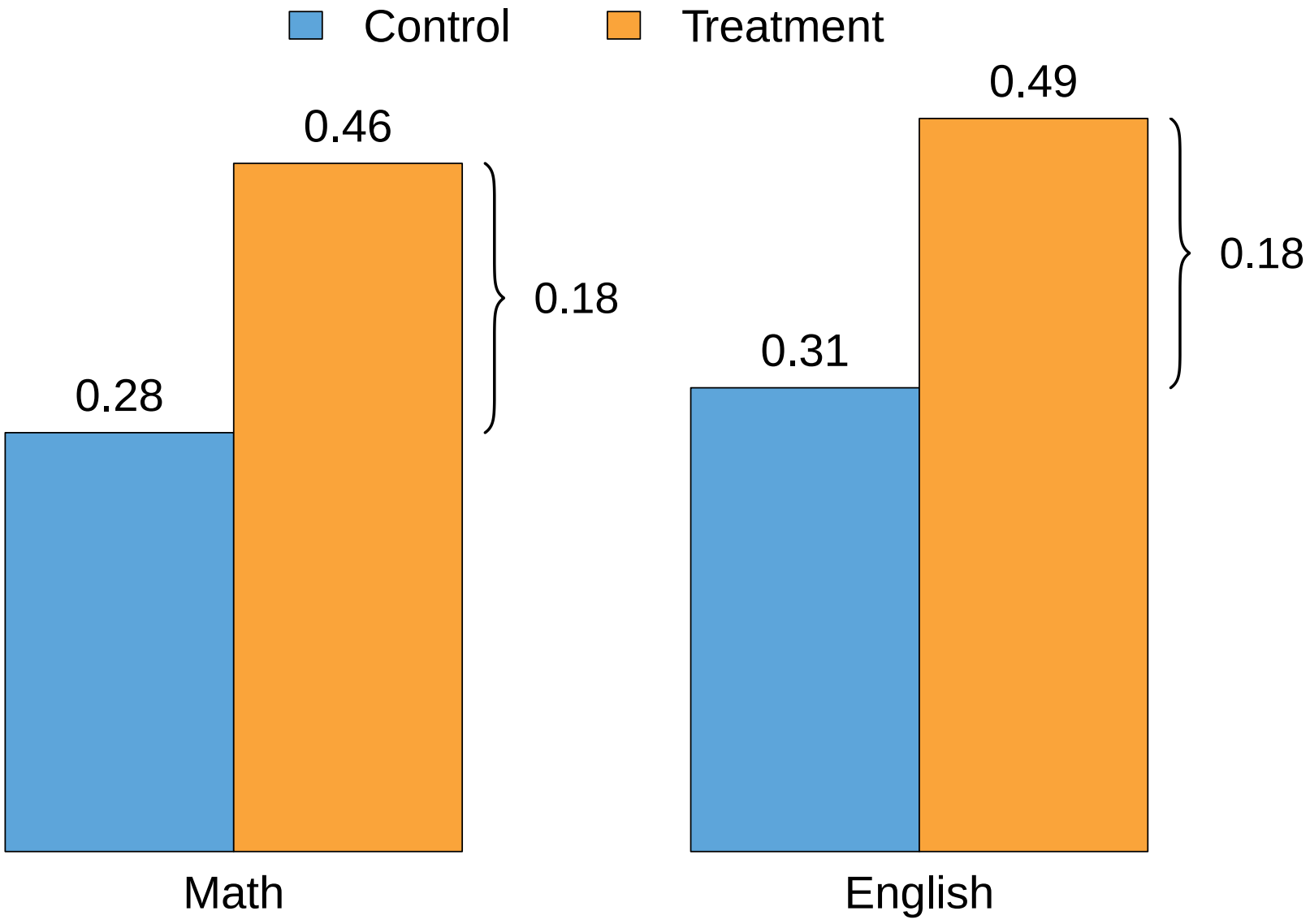
	Second wave (9-10 months after treatment)		
	ITT		ToT
	(1)	(2)	(3)
English	0.17***	0.18***	0.21***
	(0.04)	(0.03)	(0.04)
Math	0.19***	0.18***	0.22***
	(0.04)	(0.03)	(0.04)
Abstract	0.05	0.05	0.06
	(0.04)	(0.04)	(0.05)
Composite	0.19***	0.18***	0.22***
	(0.04)	(0.03)	(0.04)
Controls	No	Yes	Yes
Observations	3,492	3,492	3,492

▸ Teaching to the test? ▸ First wave ▸ Timing ▸ Without Bridge

"Business as usual" learning is .3σ per academic year



Treatment is roughly ∼0.62 extra years of schooling



Other outcomes

- No heterogeneity by school characteristics
- No heterogeneity by student characteristics
- No evidence of student selection
- No effect on enrollment (more on this soon)

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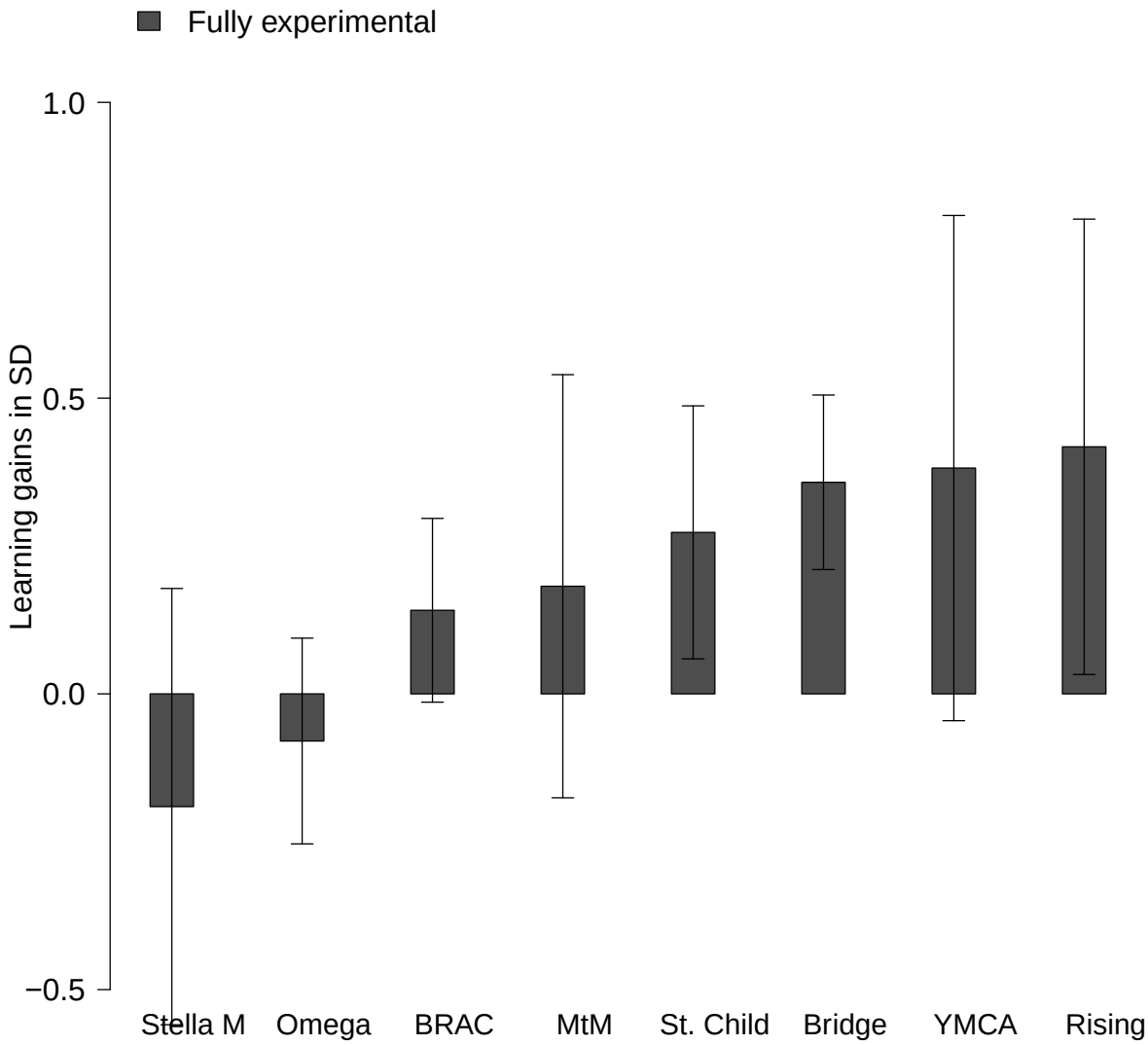
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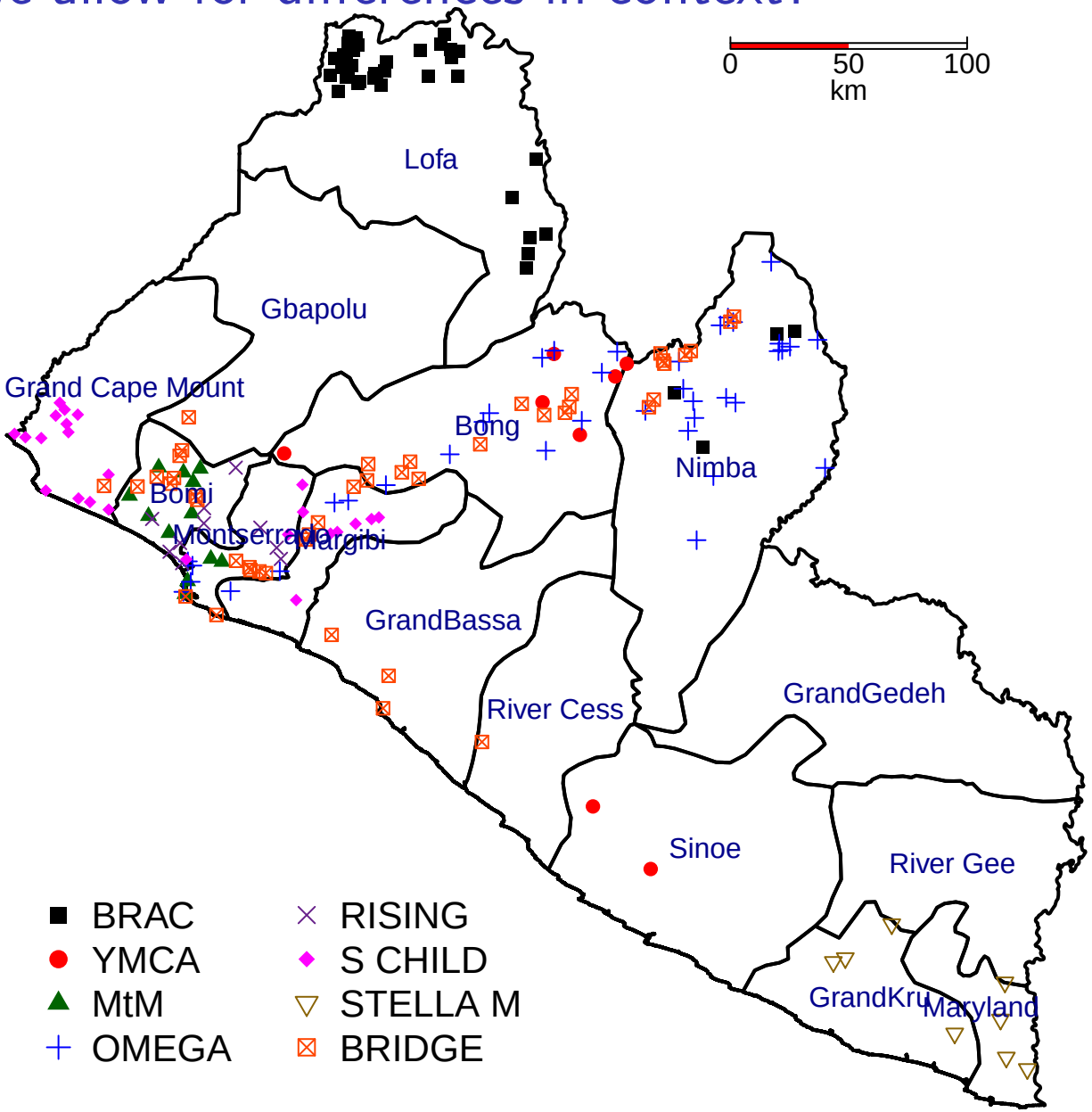
Learning outcomes by provider



Two problems when comparing providers

1. They work in different contexts
    - Raw estimates for each provider are correct (internal validity)
    - But they aren't immediately comparable (external validity)
2. Sample sizes for most providers are small

1. How do we allow for differences in context?

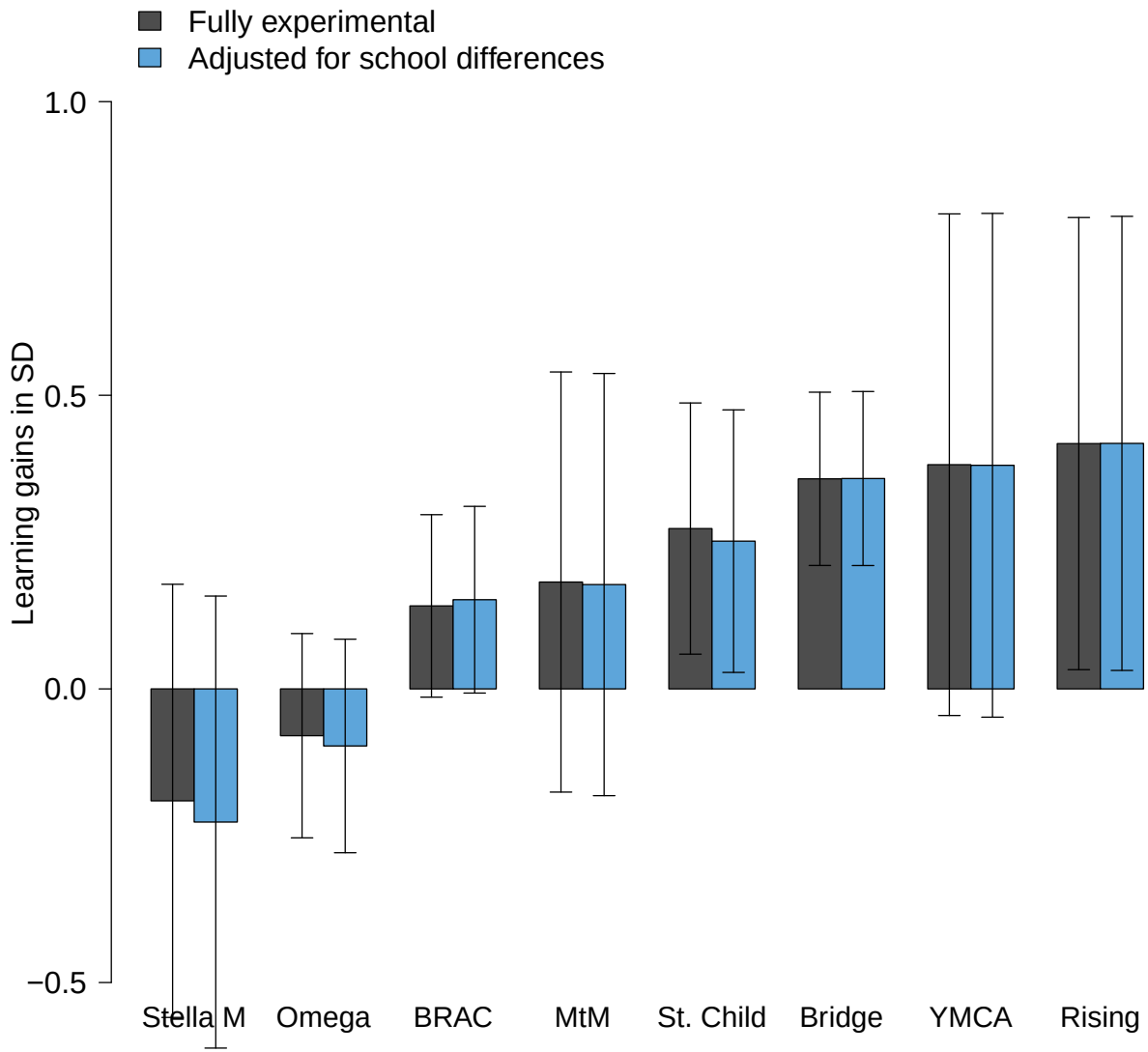


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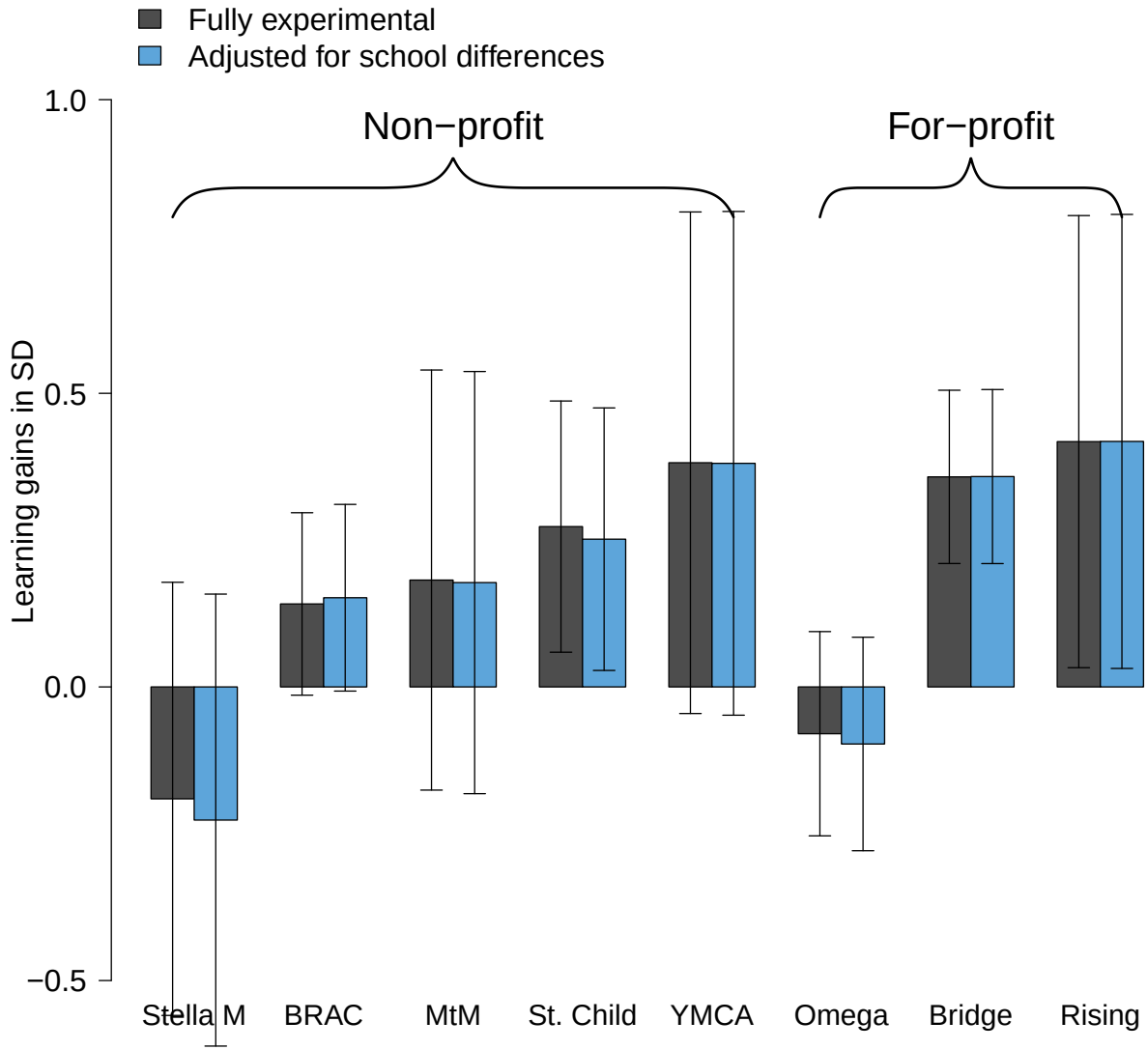
- Control for school characteristics
  - Some schools will score better for reasons unrelated to treatment
- Control for the interactions of characteristics with treatment
  - Raising scores through treatment will be easier in some contexts

▸ Controls

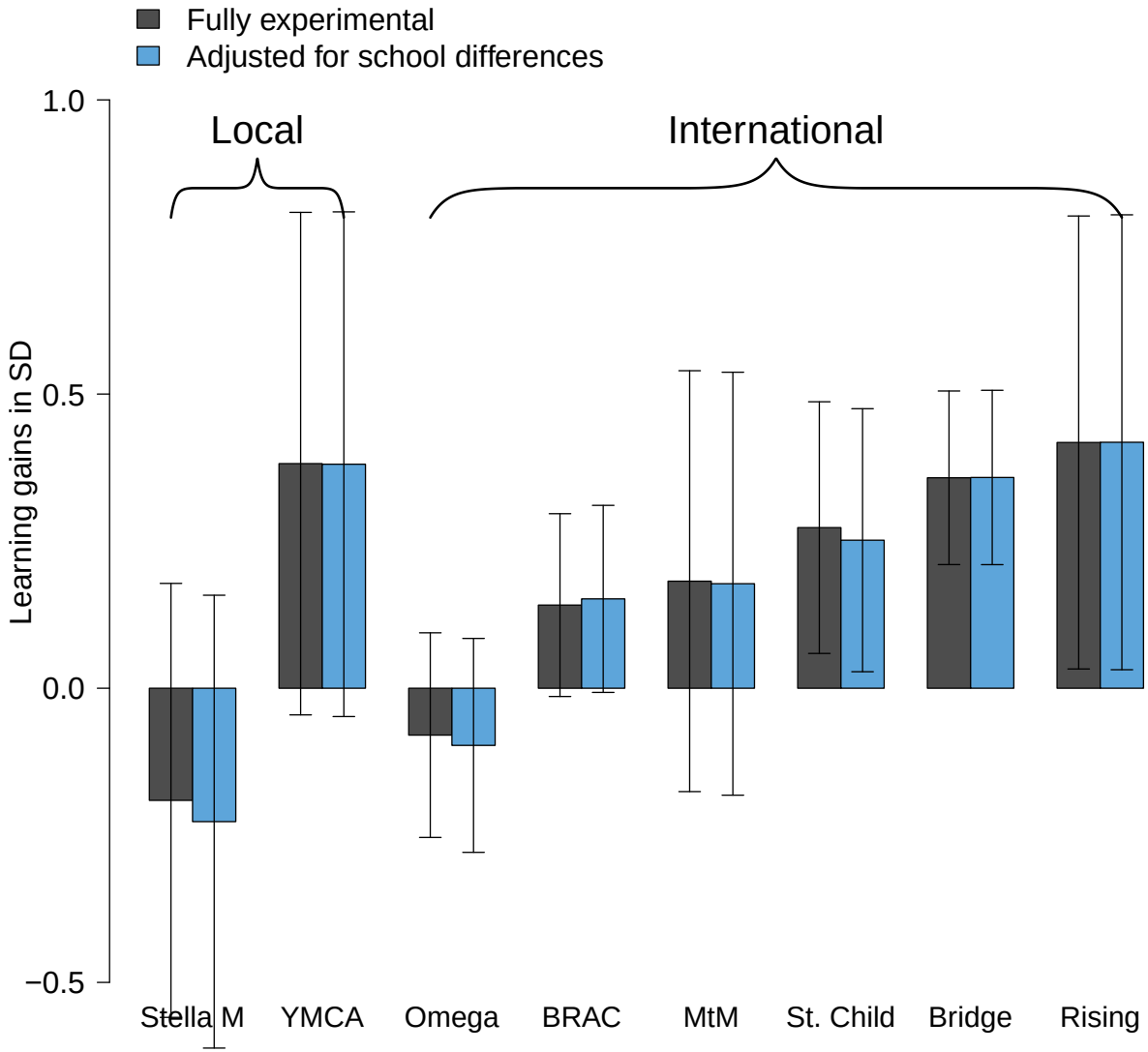
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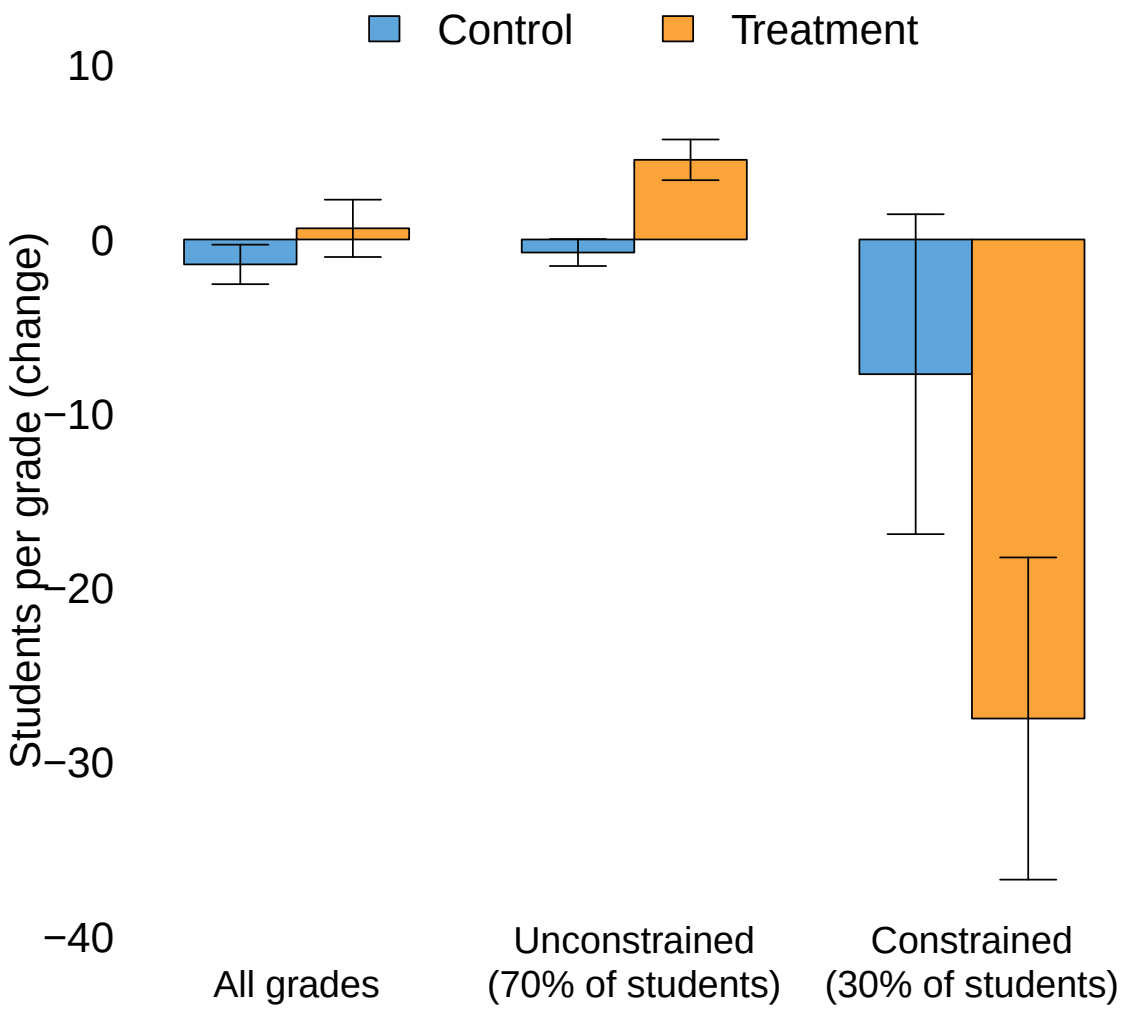
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Relevant contract details

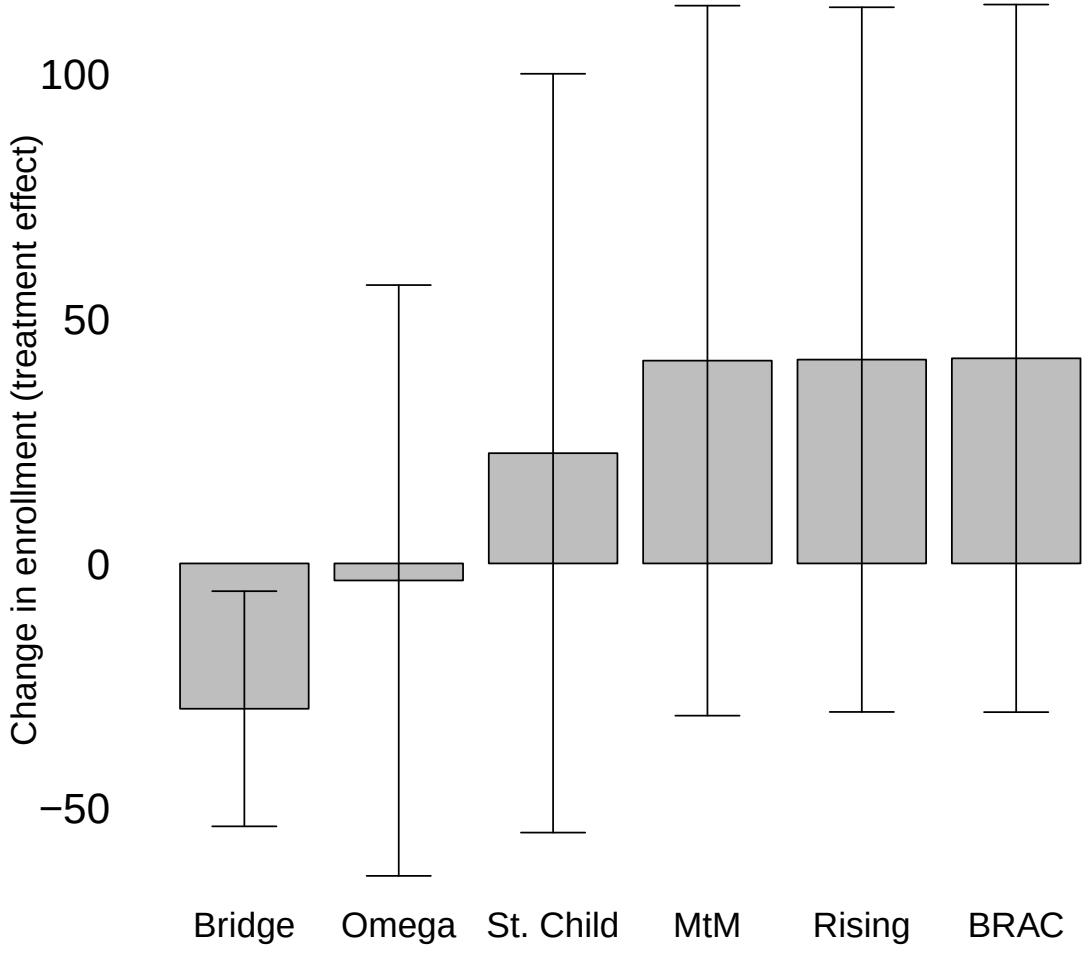
- All contractors allowed to cap class sizes
- Largest provider bypassed the competitive procurement and negotiated a bilateral agreement
  - Lump-sum grants (as opposed to per-pupil funding)
  - Limitations on removing government teachers verbally stipulated (as opposed to written in the contract)

No effect on total enrollment, but in constrained schools enrollment went down

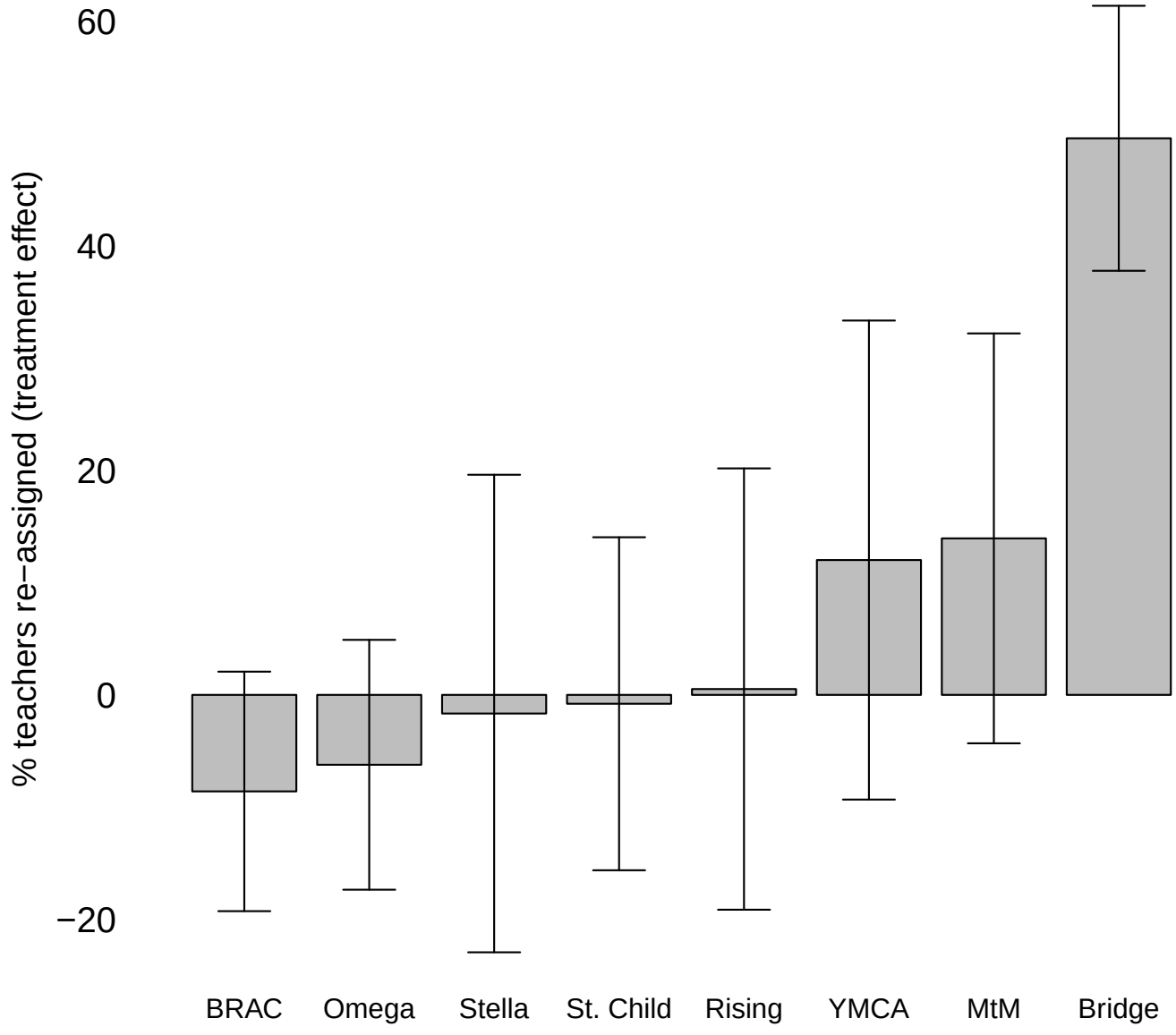


▸ Enrollment table ▸ Constrained table

Removing students from schools where class sizes were large



Removing incumbent teachers



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What explains learning gains?

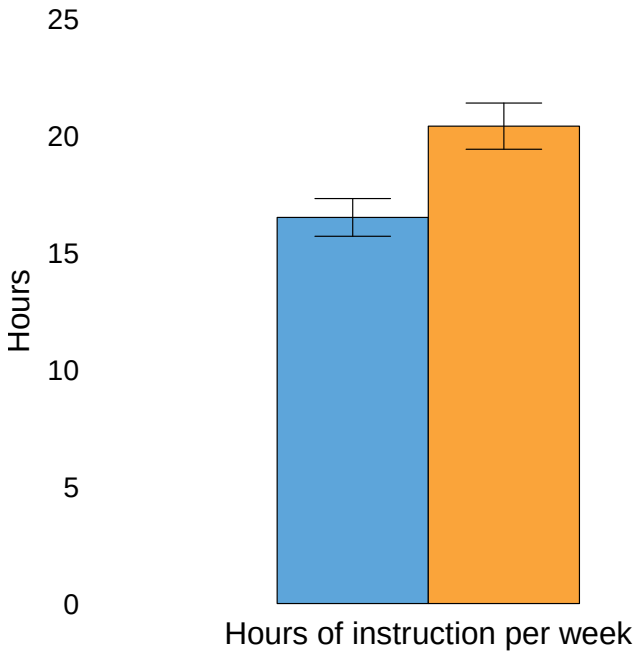
- What changed? (Experimental)
- Which changes mattered for learning outcomes? (Non-experimental)

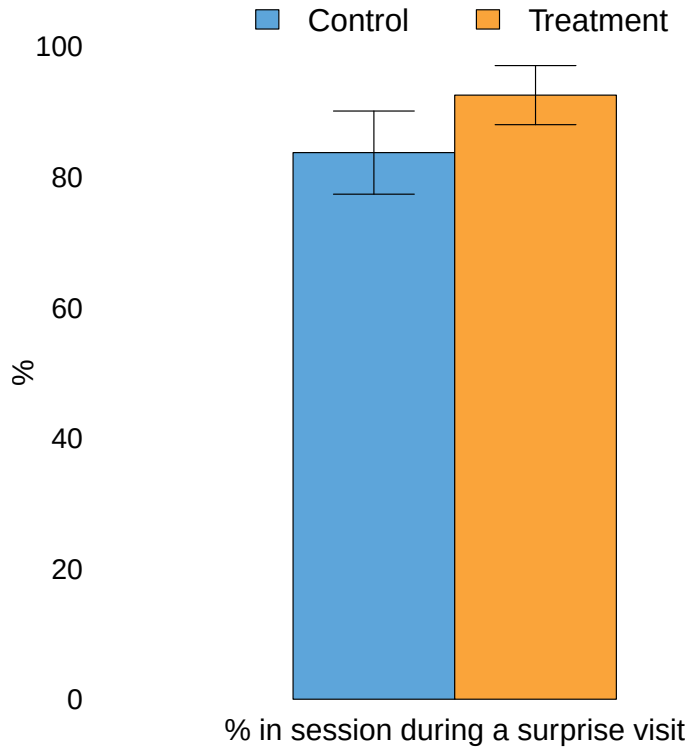
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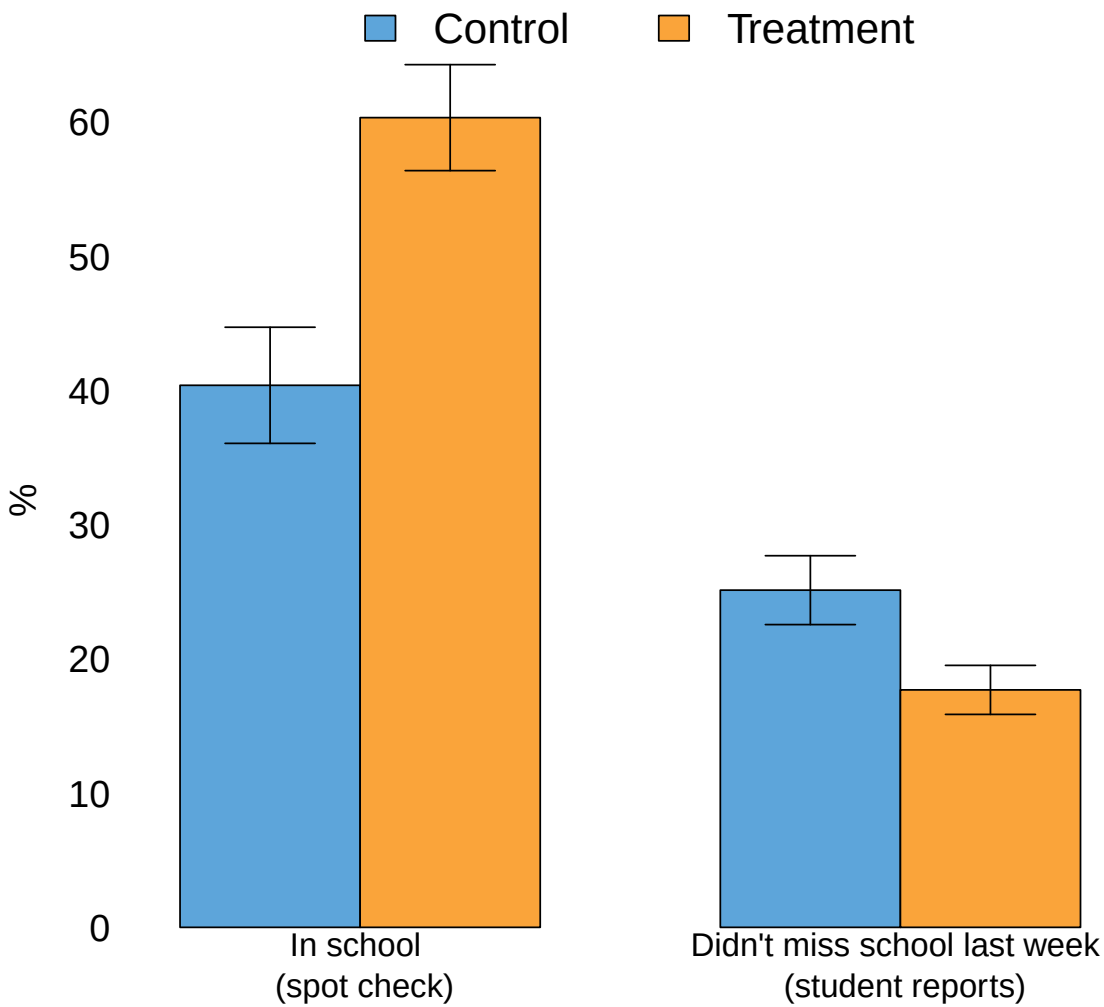
Treatment schools have more instructional time





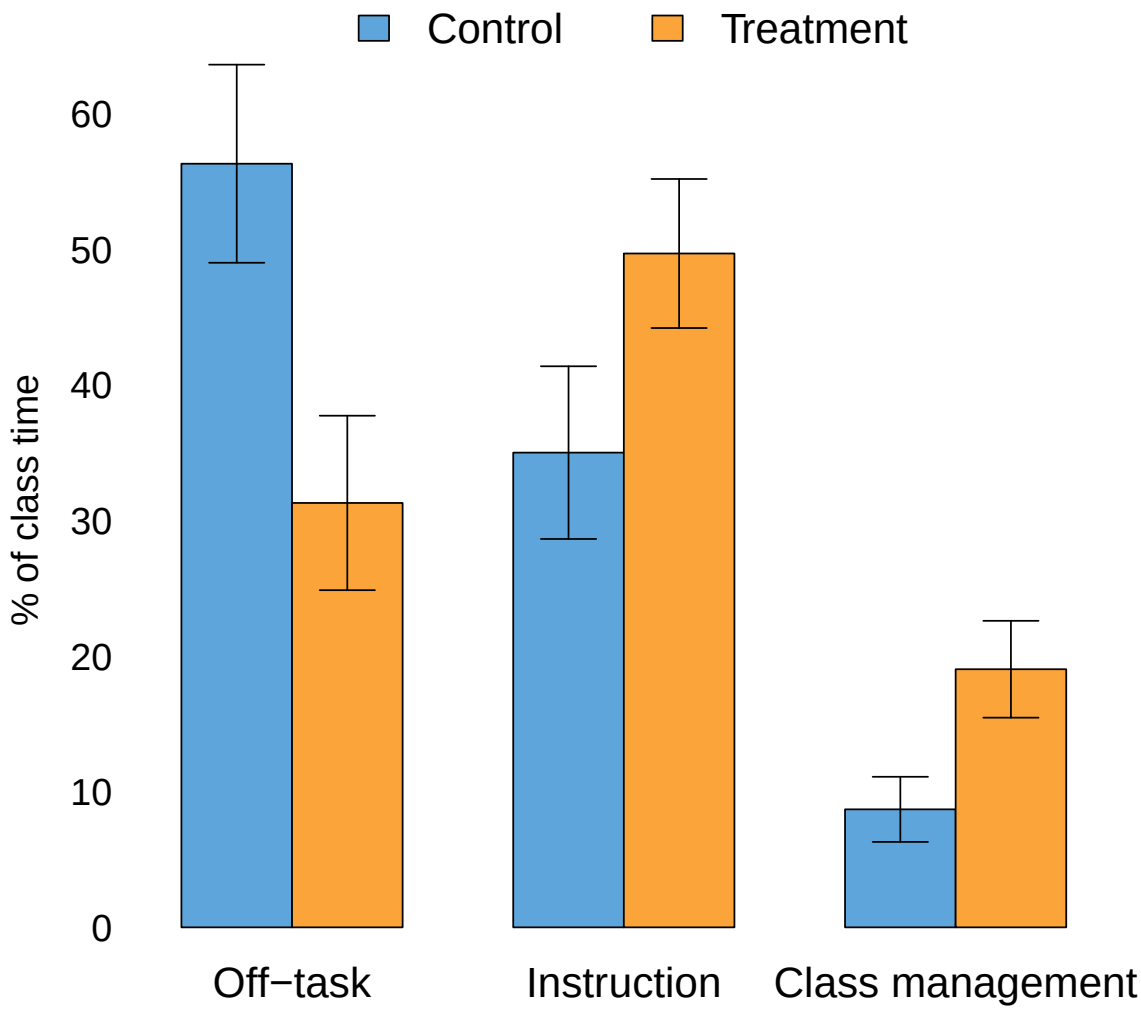
▸ Management ▸ Teachers ▸ Lee bounds ▸ By provider

Teachers are more likely to be in school...



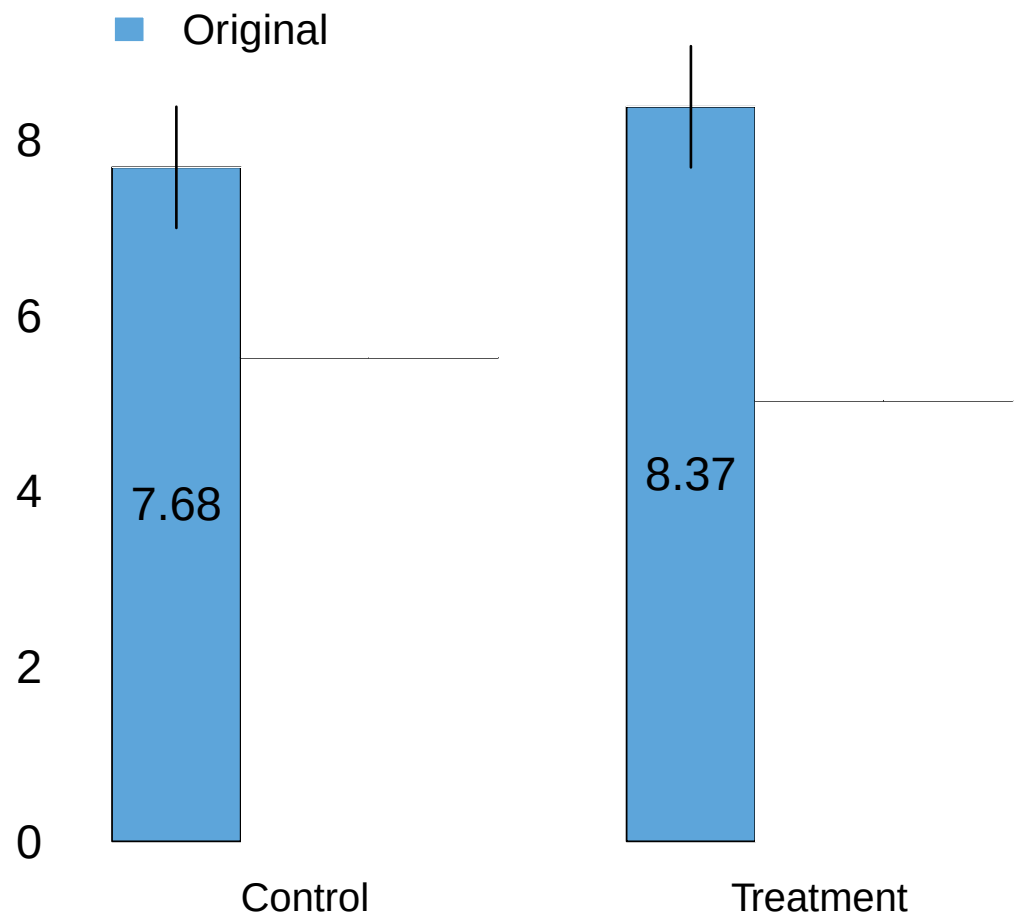
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...and quality of instruction is higher



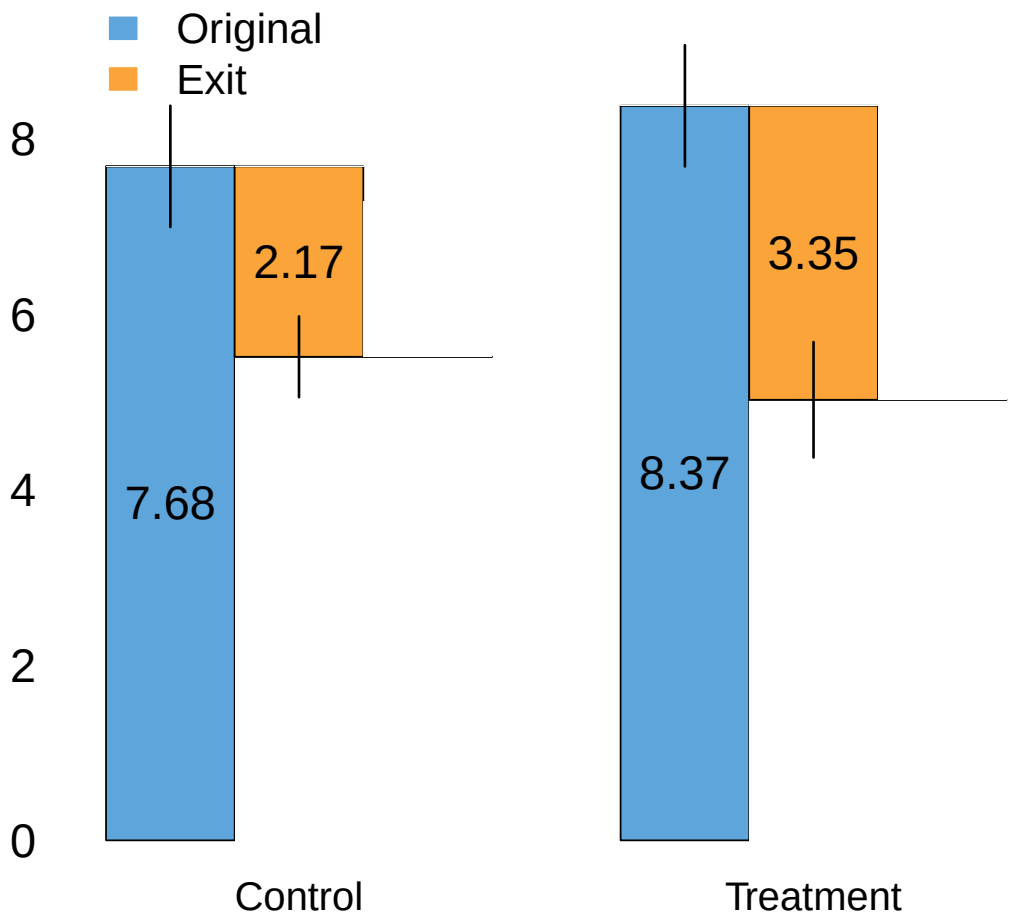
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Teachers per school: baseline, entry, and exit



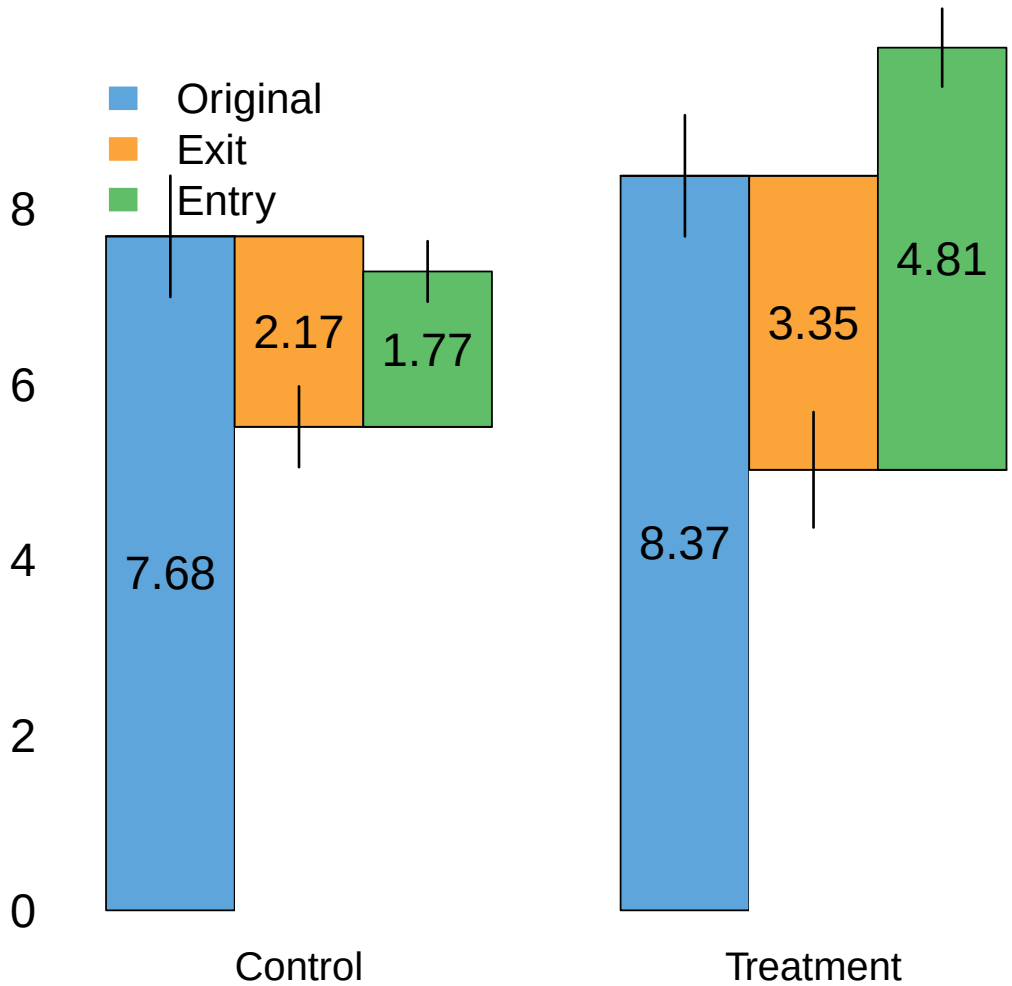
▸ Table ▸ By provider

Teachers per school: baseline, entry, and exit



▸ Table ▸ By provider

Teachers per school: baseline, entry, and exit



▸ Table ▸ By provider

Treatment schools get new teaching graduates

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Age in years	39.09	46.37	-7.28***	-7.10***
	(11.77)	(11.67)	(1.02)	(0.68)
Experience in years	10.59	15.79	-5.20***	-5.26***
	(9.20)	(10.77)	(0.76)	(0.51)
% has worked at a private school	47.12	37.50	9.62**	10.20***
	(49.95)	(48.46)	(3.76)	(2.42)
Test score in standard deviations	0.13	-0.01	0.14*	0.14**
	(1.02)	(0.99)	(0.07)	(0.06)

▸ Teachers ▸ By provider

What explains learning gains?

- What changed? (Experimental)

- **Which changes mattered for learning outcomes? (Non-experimental)**

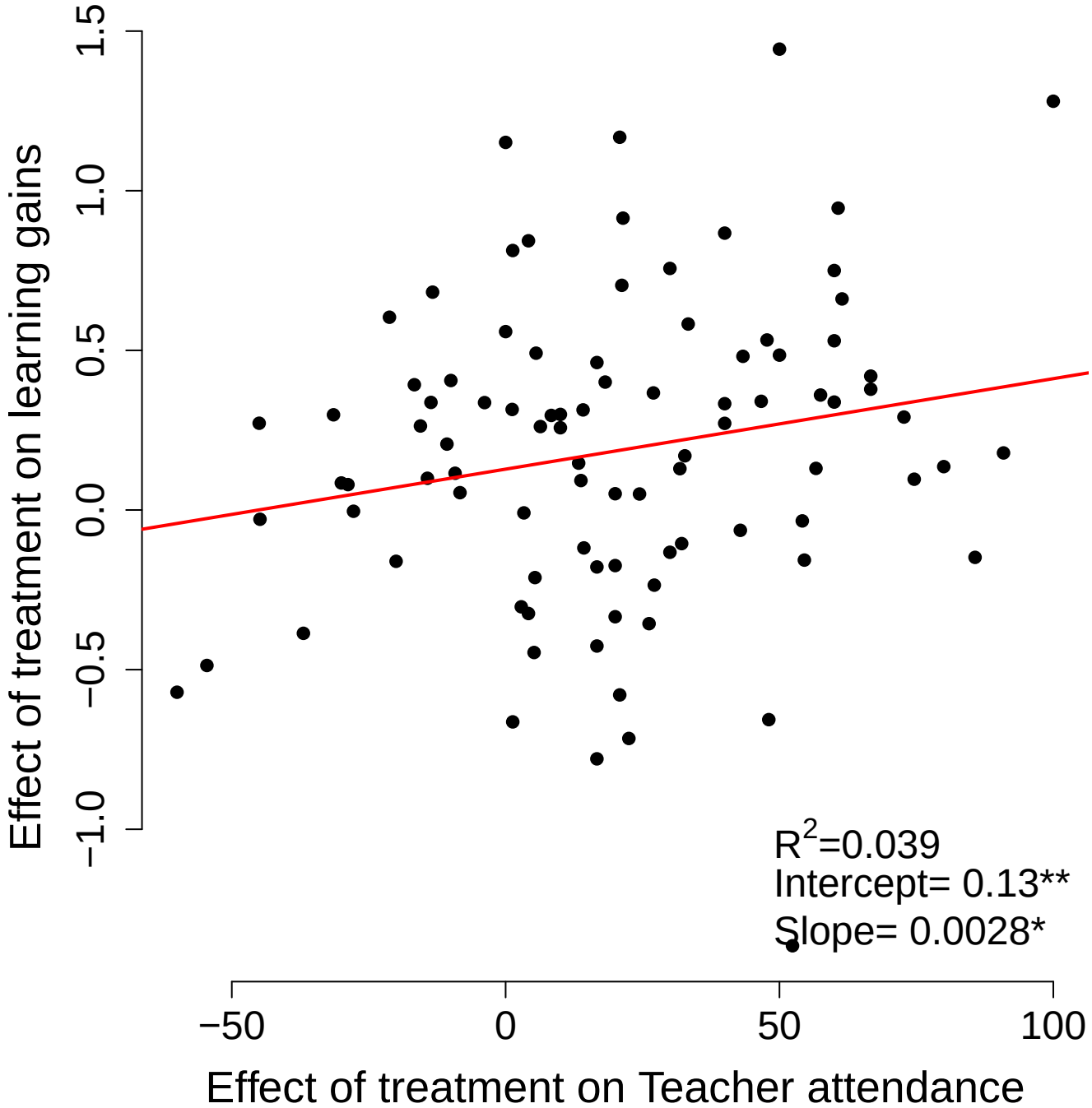
How to choose relevant variables?

- "Double Lasso" to selects relevant variables (Belloni, Chernozhukov, & Hansen, 2014; Urminsky, Hansen, & Chernozhukov, 2016) ▸ More
  - Lasso #1: What is highly correlated with learning?
  - Lasso #2: What did the experiment change?

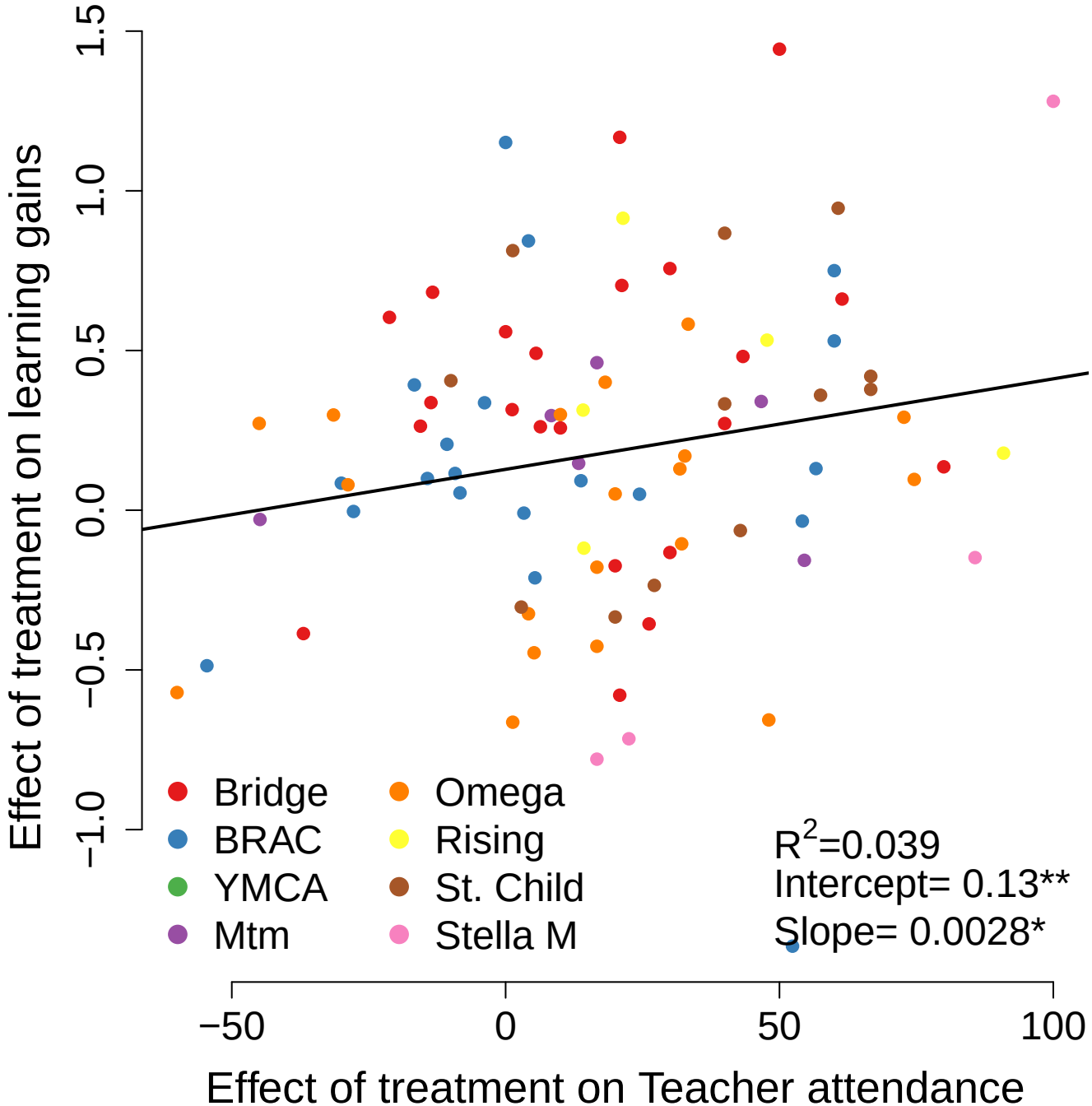
Selected variables

Teachers' age
Teacher attendance
Hrs/week
Teachers' Experience
% time management

Where teacher attendance increases, so do test scores



Where teacher attendance increases, so do test scores



Correlation between treatment effects at the match-pair level

Variable	Learning
Teachers' age	-0.37***
Teacher attendance	0.20*
Teachers' experience	-0.16
Hours/Week	0.15
% time management	0.057

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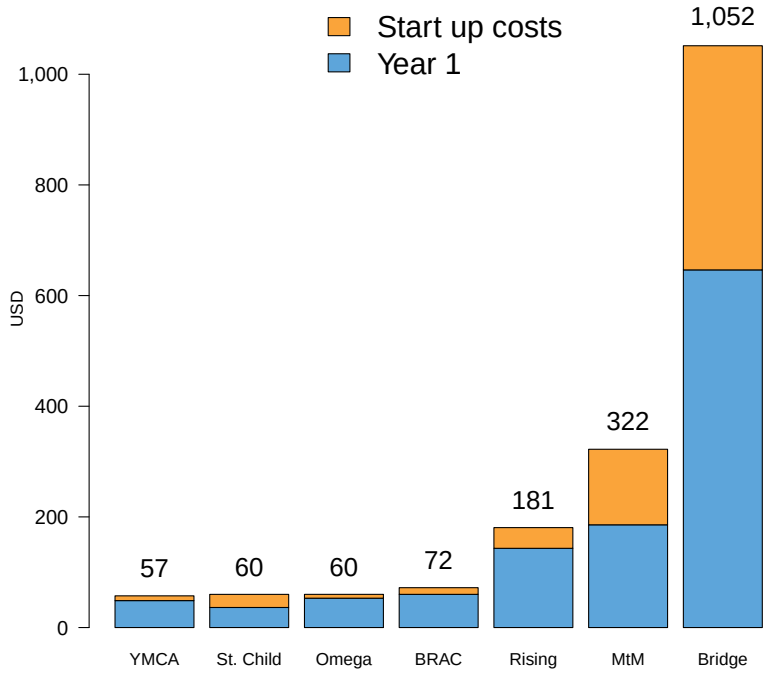
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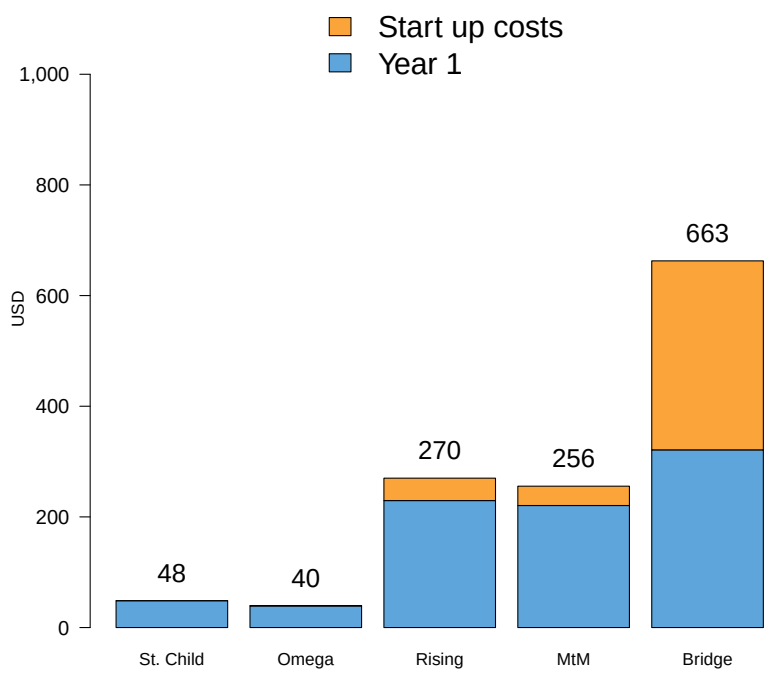
Final thoughts

Cost per pupil varies across providers

Ex ante budget per pupil



Ex post cost per pupil



We use the long term target of $50 per student

- The lowest possible cost associated with the program ($50)
- Test scores increased 0.44σ (ToT) per $100 spent
- But was PSL worth the cost?

What PSL worth the cost? Cost-benefit analysis

- Mincerian return on a year of schooling of 8.6% (Millennium Challenge Corporation, 2013)
- Counterfactual income = GDP per capita ($695)
- Discount rate of 10%

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- $\Rightarrow$ NPV of $90-$110

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- Discount rate of 10%
- $\Rightarrow$ NPV of $90-$110
- $NPV > 0$ if cost is below $ 160



What PSL worth the cost? Cost-effectiveness analysis

- The PSL program reflects a fairly holistic (and costly) overhaul of how public schools are run
- Comparing it to the treatment effects of marginal improvements to existing school systems may be uninformative
- A more informative comparison is between PSL and business-as-usual public schools

What PSL worth the cost? Cost-effectiveness analysis

- Learning gains equivalent to 0.6 extra years of schooling at a cost $50-$70.
- Making heroic assumption that existing school system has linear costs, can be expanded as is . . .

What PSL worth the cost? Cost-effectiveness analysis

- Learning gains equivalent to 0.6 extra years of schooling at a cost \$50-\$70.
- Making heroic assumption that existing school system has linear costs, can be expanded as is ...
- $\Rightarrow$ PSL $<$ business as usual
- Likely unrealistic that government is able to double learning gains by doubling expenditure

What PSL worth the cost? Cost-effectiveness analysis

- Assume government follows its current pattern of spending almost exclusively on teachers salaries
- Likely have no effect on test scores
  - Teacher salaries (de Ree, Muralidharan, Pradhan, & Rogers, 2018)
  - PTR (Duflo, Dupas, & Kremer, 2015; Banerjee, Cole, Duflo, & Linden, 2007)
- Using data from control schools, we estimate that
  - Spending an extra USD 50 would cut PTR in half
  - Increase test scores by $.027\sigma$

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Can outsourcing public education raise learning levels in fragile states?

- .18σ $\sim$0.62 extra years of schooling
- Highest performing=0.26σ, lowest=0
- Largest provider unenrolled pupils from schools with large class sizes and removed 74% of incumbent teachers
- Beyond our scope here, but multiple scandals related to child protection (MtM and YMCA)
- Questions regarding contracts/procurement
  - Contracts are incomplete and subject to regulatory capture
  - Managing/contracting providers requires state capacity
  - Competition requires active encouragement

Thank you

- Gracias
- Asante Sana
- Merci
- Obrigado
- Grazie

PSL and traditional public schools

	Control schools	PSL treatment schools
Management		
Who owns school building?	Government	Government
Who employs and pays teachers?	Government	Government
Who manages the school and teachers?	Government	Provider
Who sets curriculum?	Government	Government + provider supplement
Funding		
Primary user fees (annual USD)	Zero	Zero
ECE user fees (annual USD)	$38	Zero
Extra funding per pupil (annual USD)	NA	$50 + independent fund-raising
Staffing		
Pupil-teacher ratios	NA	Promised one teacher per grade, allowed to cap class sizes at 45-65 pupils
New teacher hiring	NA	First pick of new teacher-training graduates

Back

	Liberia PSL	South Africa	UK Academy	USA Charters	Punjab PSSP	Punjab vouchers	Philippines vouchers	India RTE	Uganda Secondary
Year started	2016	2016	2001	1991	2016	2006	2005	2012	2007
# Schools	93	7	5,000	7,000	500	1,700	c. 6,000	91,000	800
# Students	27,000	6,000	2million+	2.7million	c. 50,000	500,000	c. 1million	c. 1.7mill	440,000
Type	Contract Mgmt	Contract Mgmt	Contract Mgmt	Contract Mgmt	Contract Mgmt	Voucher	Voucher	Subsidy	Subsidy
No fee?	✓	✓	✓	✓	✓	✘	✘	✓	✘
Non-profit?	✘	✓	✓	-	✓	✘	✘	✓	✘
Non-selective?	✓	✓	✓	✓	✓	✓	✘	✘	✘
Govt teacher contracts	✓	-	-	✘	✘	✘	✘	✘	✘
Teachers in unions	✓	✓	✓	✘	✘	✘	✘	✘	✘
Accountable for outcomes	✓	✓	✓	✓	✓	✓	✓	✘	✘
National curriculum	✓	✓	✘	-	✓	✓	✓	✓	✓
Govt buildings	✓	✓	✓	-	✓	✘	✘	✘	✘

More public ⟷ More private

Source: Ark

Back

What do providers do? Depends on the provider

- Textbooks/Paper/Notebook: YMCA/BRAC/MtM
- Technology (e.g., scripted lessons in tablets): Bridge/Omega
- Community engagement: MtM/Rising/St Child
- Teacher training: Rising
- Teacher guides: Rising/MtM/Bridge

▸ Back ▸ More details

What do providers do? Depends on the provider

		Provider							
		Stella M	YMCA	Omega	BRAC	Bridge	Rising	St. Child	MtM
Provider Support	Provider staff visits at least once a week(%)	0	54	13	93	76	94	91	96
	Heard of PSL(%)	42	85	61	42	87	90	68	85
	Heard of (provider)(%)	46	96	100	95	100	100	100	100
	Has anyone from (provider) been to this school?(%)	42	88	100	94	100	100	99	100
Ever provided	Textbooks(%)	12	96	73	94	99	71	94	96
	Teacher training(%)	0	77	62	85	87	97	93	96
	Teacher received training since Aug 2016(%)	23	46	58	45	50	81	58	37
	Teacher guides (or teacher manuals)(%)	0	69	75	54	97	94	68	98
	School repairs(%)	0	12	25	24	53	52	13	93
	Paper(%)	0	92	30	86	70	97	88	98
	Organization of community meetings(%)	0	54	27	69	73	87	83	91
	Food programs(%)	0	8	2	1	1	10	0	17
	Copybooks(%)	4	65	30	92	18	97	94	91
	Computers, tablets, electronics(%)	0	0	94	0	99	3	3	2
Most recent visit	Provide/deliver educational materials(%)	0	4	45	17	18	26	29	50
	Observe teaching practices and give suggestions(%)	0	19	45	81	65	45	74	85
	Monitor/observe PSL program(%)	0	12	23	11	13	13	35	65
	Monitor other school−based government programs(%)	0	0	7	5	10	6	18	9
	Monitor health/sanitation issues(%)	0	8	9	2	5	0	10	28
	Meet with PTA committee(%)	0	12	8	10	7	0	21	41
	Meet with principal(%)	0	12	54	36	38	6	51	63
	Deliver information(%)	0	12	36	16	8	6	16	35
	Check attendance and collect records(%)	42	23	43	56	39	19	66	70
	Ask students questions to test learning(%)	4	4	24	33	18	58	44	43

Back

Schools in the RCT are better than the average public school in the country

	(1) RCT (Treatment and control)	(2) Other public schools	(3) Difference
Students: ECE	142.68	112.71	29.97
	(73.68)	(66.46)	(5.77)
Students: Primary	151.55	132.38	19.16
	(130.78)	(143.57)	(10.18)
Students	291.91	236.24	55.67
	(154.45)	(170.34)	(12.15)
Classrooms per 100 students	1.17	0.80	0.37
	(1.63)	(1.80)	(0.13)
Teachers per 100 students	3.04	3.62	-0.58
	(1.40)	(12.79)	(0.28)
Textbooks per 100 students	99.21	102.33	-3.12
	(96.34)	(168.91)	(7.88)
Chairs per 100 students	20.71	14.13	6.58
	(28.32)	(51.09)	(2.38)
Food from Gov or NGO	0.36	0.30	0.06
	(0.48)	(0.46)	(0.04)
Solid building	0.36	0.28	0.08
	(0.48)	(0.45)	(0.04)
Water pump	0.62	0.45	0.17
	(0.49)	(0.50)	(0.04)
Latrine/toilet	0.85	0.71	0.14
	(0.33)	(0.45)	(0.03)
Observations	185	2,420	2,605

▸ Back

Time-invariant characteristics are balanced and attrition is low

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Facilities (PCA)	-0.003	-0.080	-0.077	-0.070
	(0.169)	(0.156)	(0.230)	(0.232)
% holds some classes outside	14.130	13.978	-0.152	0.000
	(3.652)	(3.615)	(5.138)	(5.094)
% rural	80.435	79.570	-0.865	-0.361
	(4.159)	(4.204)	(5.913)	(4.705)
Travel time to nearest bank (mins)	68.043	75.129	7.086	7.079
	(6.308)	(7.165)	(9.547)	(8.774)

▸ EMIS ▸ Back

Time-invariant characteristics are balanced and attrition is low

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Age in years	12.291	12.394	0.104	0.059
	(0.070)	(0.068)	(0.169)	(0.112)
% male	56.146	54.949	-1.197	-1.459
	(1.184)	(1.190)	(2.041)	(1.247)
Wealth index	0.024	-0.006	-0.030	0.011
	(0.037)	(0.037)	(0.140)	(0.060)
% in top wealth quartile	0.219	0.199	-0.020	-0.018
	(0.010)	(0.010)	(0.026)	(0.014)
% in bottom wealth quartile	0.284	0.267	-0.017	-0.011
	(0.011)	(0.011)	(0.039)	(0.019)
ECE before grade 1	0.818	0.832	0.014	0.013
	(0.009)	(0.009)	(0.025)	(0.017)

▸ EMIS ▸ Back

Time-invariant characteristics are balanced and attrition is low

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
% interviewed	95.74	95.60	-0.14	-0.35
	(0.48)	(0.49)	(0.64)	(0.44)

▸ First wave ▸ Back

Balance using EMIS data

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Students: ECE	148.51	136.72	11.79	11.03
	(76.83)	(70.24)	(10.91)	(9.74)
Students: Primary	159.05	143.96	15.10	15.68
	(163.34)	(86.57)	(19.19)	(16.12)
Students	305.97	277.71	28.26	27.56
	(178.49)	(124.98)	(22.64)	(19.46)
Classrooms per 100 students	1.21	1.13	0.09	0.08
	(1.62)	(1.65)	(0.24)	(0.23)
Teachers per 100 students	3.08	2.99	0.09	0.09
	(1.49)	(1.30)	(0.21)	(0.18)
Textbooks per 100 students	102.69	95.69	7.00	7.45
	(97.66)	(95.40)	(14.19)	(13.74)
Chairs per 100 students	18.74	22.70	-3.96	-4.12
	(23.06)	(32.81)	(4.17)	(3.82)
Food from Gov or NGO	0.36	0.36	-0.01	-0.01
	(0.48)	(0.48)	(0.08)	(0.05)
Solid building	0.39	0.33	0.06	0.06
	(0.49)	(0.47)	(0.07)	(0.06)
Water pump	0.56	0.67	-0.11	-0.12
	(0.50)	(0.47)	(0.07)	(0.06)
Latrine/toilet	0.85	0.86	-0.01	-0.01
	(0.35)	(0.32)	(0.05)	(0.05)
Observations	92	93	185	185

Back

First wave sampling

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Number of students sampled	24.8	24.6	0.13	0.035
	(5.74)	(5.10)	(0.81)	(0.81)
Found at the school	18.2	16.7	1.49	1.555
	(2.30)	(4.70)	(0.55)	(0.54)
Found at home	1.73	2.91	-1.18	-1.223
	(2.12)	(3.97)	(0.48)	(0.47)
Interviewed	19.9	19.6	0.32	0.344
	(0.89)	(2.23)	(0.25)	(0.27)
Observations	88	90	178	171

Back

Control variables

Student controls
Wealth index
Age
Gender
Grade (2015/2016)

School controls
Enrollment (2015/2016)
Infrastructure quality (2015/2016)
Travel time to nearest bank
Rurality

Back

Test scores increased by .18σ

	First wave (1-2 months after treatment)	Second wave (9-10 months after treatment)	
	ITT	ITT	ToT
		(4)	(5)	(6)
English		0.17	0.18	0.21
		(0.04)	(0.03)	(0.04)
Math		0.19	0.18	0.22
		(0.04)	(0.03)	(0.04)
Abstract		0.05	0.05	0.06
		(0.04)	(0.04)	(0.05)
Composite		0.19	0.18	0.22
		(0.04)	(0.03)	(0.04)
New modules		0.20	0.19	0.23
		(0.04)	(0.04)	(0.04)
Conceptual		0.13	0.12	0.15
		(0.04)	(0.04)	(0.05)
Controls		No	Yes	Yes
Observations		3,492	3,492	3,492

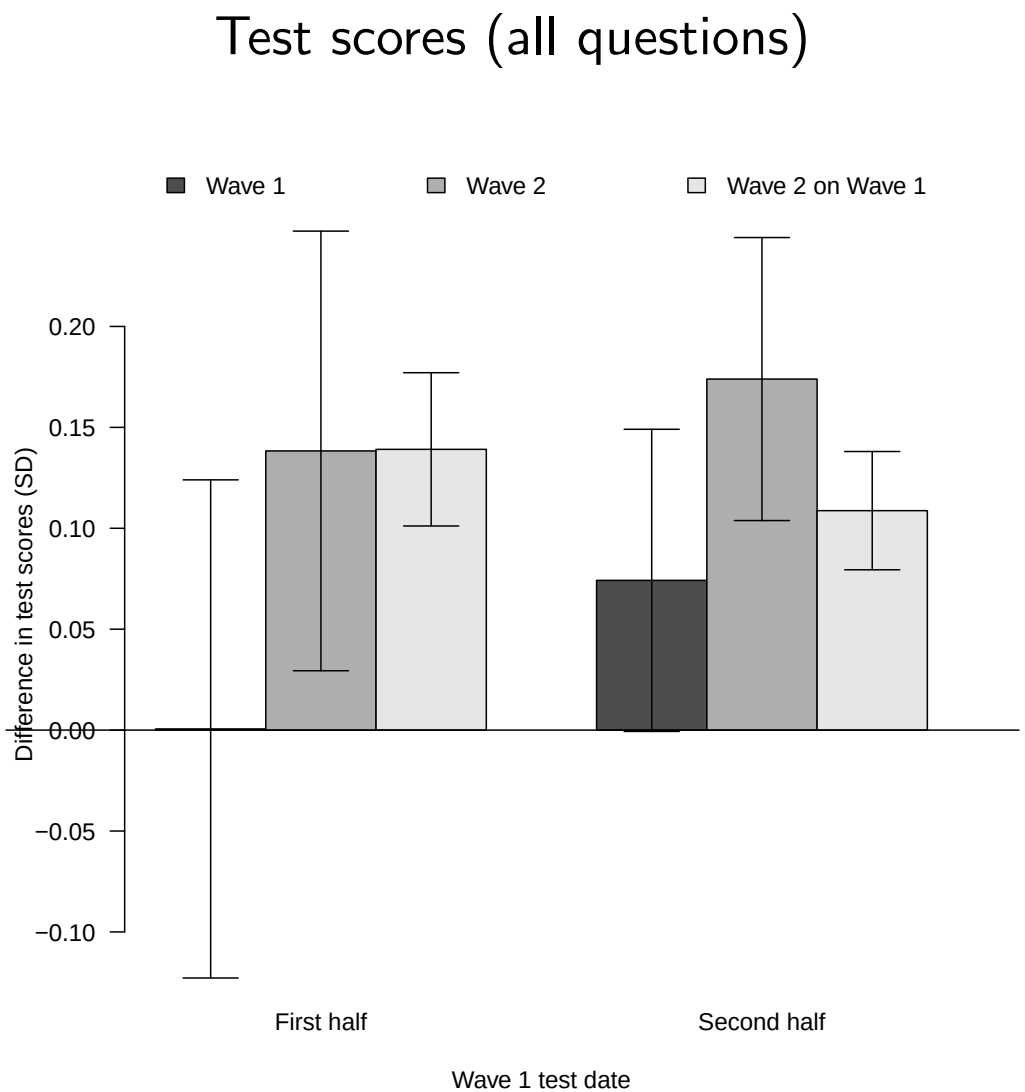
▸ Back ▸ Without Bridge

Without Bridge: Test scores increased by 0.1σ

	One year follow-up		
	Difference	Difference (F.E.)	Difference (F.E. + Controls)
	(1)	(2)	(3)
English	0.13*	0.13***	0.13***
	(0.07)	(0.04)	(0.03)
Math	0.09	0.09**	0.10***
	(0.06)	(0.04)	(0.03)
Abstract	0.03	0.03	0.04
	(0.05)	(0.03)	(0.04)
Composite	0.10	0.10***	0.11***
	(0.07)	(0.04)	(0.03)
New modules	0.17**	0.20***	0.19***
	(0.07)	(0.04)	(0.04)
Conceptual	0.12**	0.13***	0.12***
	(0.05)	(0.04)	(0.04)
Observations	2,643	2,643	2,643

Back

First round of data is "contaminated" by short-run treatment effects



Back

PPP increased test scores by .18σ

	First wave (1-2 months after treatment)			Second wave (9-10 months after treatment)		
	ITT		ToT	ITT		ToT
	(1)	(2)	(3)	(4)	(5)	(6)
English	0.09	0.07	0.08	0.17	0.18	0.21
	(0.05)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)
Math	0.07	0.05	0.06	0.19	0.18	0.22
	(0.04)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)
Abstract	0.05	0.03	0.04	0.05	0.05	0.06
	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Composite	0.08	0.06	0.07	0.19	0.18	0.22
	(0.05)	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)
New modules				0.20	0.19	0.23
				(0.04)	(0.04)	(0.04)
Conceptual				0.13	0.12	0.15
				(0.04)	(0.04)	(0.05)
Controls	No	Yes	Yes	No	Yes	Yes
Observations	3,508	3,508	3,508	3,492	3,492	3,492

▸ Back ▸ Without Bridge

Without Bridge: PPP increased test scores by .18σ

	Baseline		One year follow-up			
	Difference	Difference (F.E.)	Difference	Difference (F.E.)	Difference (F.E. + Controls)	Difference (ANCOVA)
	(1)	(2)	(3)	(4)	(5)	(6)
English	-0.00	0.03	0.13*	0.13***	0.13***	0.11***
	(0.09)	(0.04)	(0.07)	(0.04)	(0.03)	(0.03)
Math	0.00	-0.00	0.09	0.09**	0.10***	0.09***
	(0.07)	(0.04)	(0.06)	(0.04)	(0.03)	(0.02)
Abstract	0.01	0.02	0.03	0.03	0.04	0.04
	(0.07)	(0.05)	(0.05)	(0.03)	(0.04)	(0.03)
Composite	-0.00	0.01	0.10	0.10***	0.11***	0.10***
	(0.08)	(0.04)	(0.07)	(0.04)	(0.03)	(0.02)
New modules			0.17**	0.20***	0.19***	0.16***
			(0.07)	(0.04)	(0.04)	(0.03)
Conceptual			0.12**	0.13***	0.12***	0.10***
			(0.05)	(0.04)	(0.04)	(0.04)
Observations	2,654	2,654	2,643	2,643	2,643	2,643

Back

No heterogeneity by student characteristics

	Male	Top wealth quartile	Bottom wealth quartile	Grade
	(1)	(2)	(3)	(4)
Treatment	0.20	0.18	0.17	0.16
	(0.047)	(0.035)	(0.035)	(0.10)
Treatment × covariate	-0.021	0.029	0.061	0.0050
	(0.068)	(0.066)	(0.050)	(0.020)
No. of obs.	3,492	3,492	3,492	3,492

▸ Distribution plots ▸ Quantile treatment effects ▸ Without Bridge ▸ Back

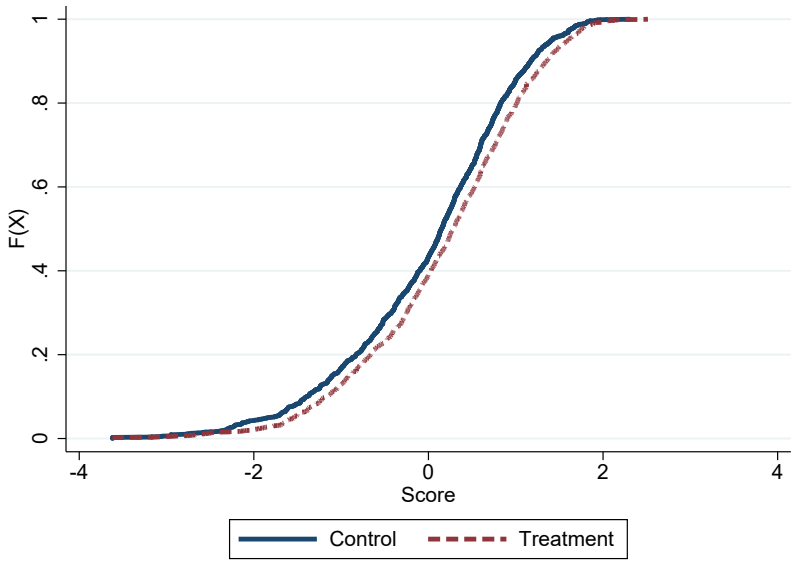
Quantile treatment effects

Quantile	0.1	0.25	0.5	0.75	0.9
	(1)	(2)	(3)	(4)	(5)
Panel A: Math					
Treatment	0.24***	0.22***	0.15***	0.13***	0.24***
	(0.039)	(0.027)	(0.027)	(0.023)	(0.019)
No. of obs.	3,492	3,492	3,492	3,492	3,492
Panel B: English					
Treatment	0.13***	0.14***	0.16***	0.18***	0.20***
	(0.023)	(0.024)	(0.019)	(0.021)	(0.021)
No. of obs.	3,492	3,492	3,492	3,492	3,492
Panel C: Composite					
Treatment	0.22***	0.21***	0.15***	0.18***	0.22***
	(0.030)	(0.026)	(0.022)	(0.021)	(0.024)
No. of obs.	3,492	3,492	3,492	3,492	3,492

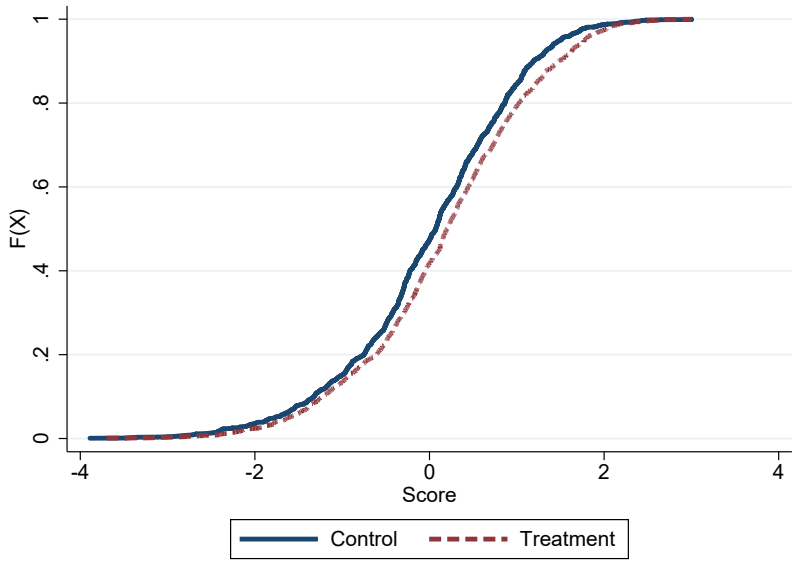
▸ Distribution plots ▸ Back

Distribution plots

Math



English



▸ Quantile ▸ Back

Without Bridge: No heterogeneity by student characteristics

	Male (1)	Top wealth quartile (2)	Bottom wealth quartile (3)	Grade (4)
Treatment	0.12**	0.10**	0.11***	0.15
	(0.050)	(0.040)	(0.040)	(0.11)
Treatment × covariate	0.0028	0.071	0.039	-0.0079
	(0.071)	(0.069)	(0.060)	(0.020)
No. of obs.	2,643	2,643	2,643	2,643

▸ Back

No heterogeneity by school characteristics

	Enrollment(2015/2016) (1)	Facilities (PCA) (2)	Rural (3)	Time to nearest bank (4)
Treatment	0.16	0.19	0.24	0.18
	(0.093)	(0.032)	(0.051)	(0.050)
Treatment × covariate	0.000069	-0.020	-0.068	0.000051
	(0.00029)	(0.028)	(0.077)	(0.00058)
No. of obs.	3,492	3,492	3,492	3,492

▸ Without Bridge ▸ Back

No heterogeneity by school characteristics

	Enrollment(2015/2016) (1)	Facilities (PCA) (2)	Rural (3)	Time to nearest bank (4)
Treatment	0.31***	0.11***	0.24***	0.043
	(0.11)	(0.038)	(0.050)	(0.056)
Treatment × covariate	-0.00069**	-0.031	-0.14*	0.00093
	(0.00035)	(0.034)	(0.078)	(0.00061)
No. of obs.	2,643	2,643	2,643	2,643

Back

No evidence of student selection

	(1) Same school	(2) Same school	(3) Same school
Treatment	0.061	0.012	0.021
	(0.082)	(0.026)	(0.019)
Treatment × Age	-0.0042		
	(0.0064)		
Treatment × Male		-0.011	
		(0.028)	
Treatment × Asset Index (PCA)			-0.0059
			(0.011)
No. of obs.	3,487	3,487	3,428

▸ Without Bridge ▸ Back

Without Bridge: No evidence of student selection

	(1) Same school	(2) Same school	(3) Same school
Treatment	0.061	0.012	0.021
	(0.082)	(0.026)	(0.019)
Treatment × Age	-0.0042		
	(0.0064)		
Treatment × Male		-0.011	
		(0.028)	
Treatment × Asset Index (PCA)			-0.0059
			(0.011)
No. of obs.	3,487	3,487	3,428

Back

Controls

- School characteristics (per PAP): Enrollment (2015/2016), Facilities (PCA), Rural, Time to nearest bank

- Robust to including different controls

Back

Bayesian hierarchical model

$$Y_{isgc} = \alpha_g + \beta_c treat_s + \varepsilon_{isgc} \tag{3}$$

$$\widehat{\beta}_c \sim N(\beta_c, \sigma_c^2) \tag{4}$$

The Bayesian hierarchal model further assumes that

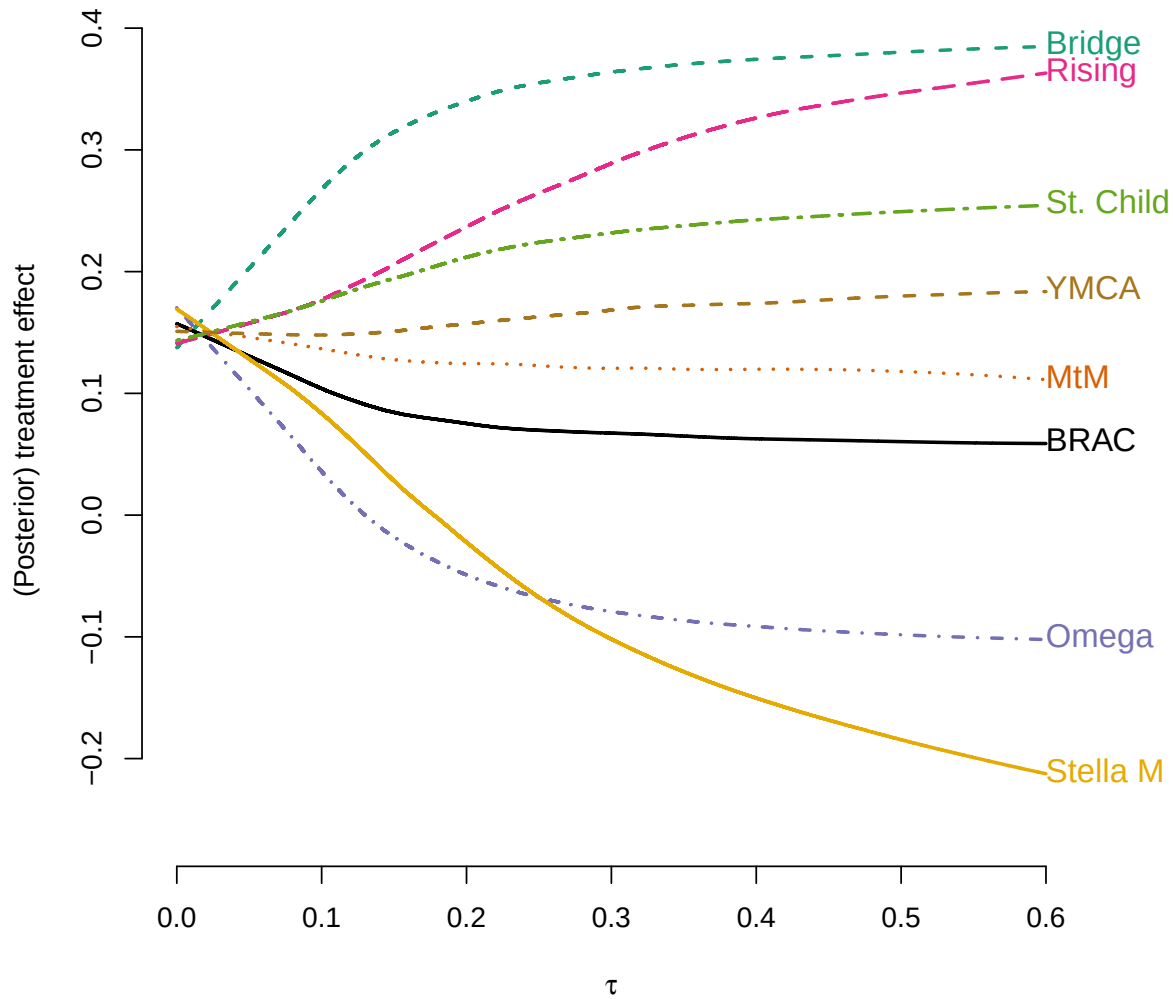
$$\beta_c \sim N(\mu, \tau^2) \tag{5}$$

1. Place a prior distribution over μ and τ^2

2. Estimate the posterior distribution of β_c

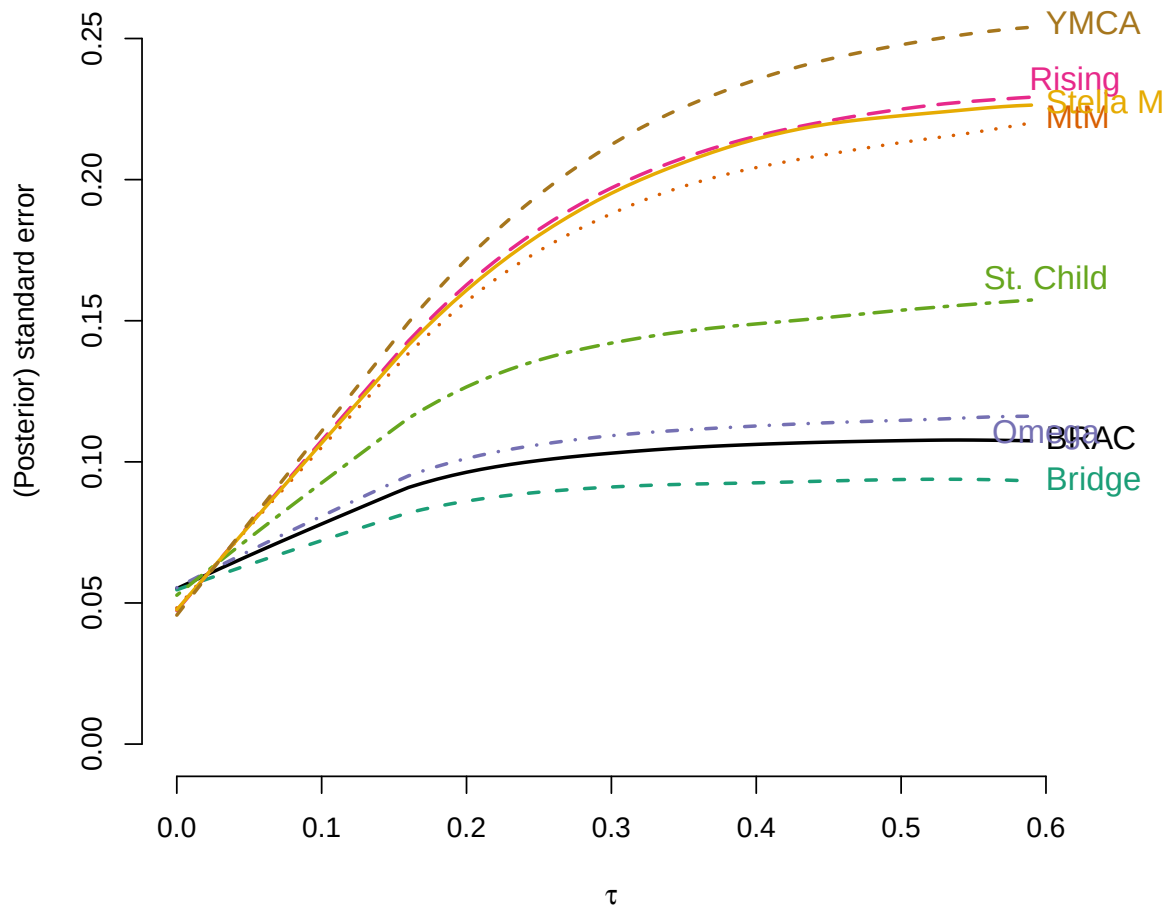
▸ Prior choice ▸ Posteriors ▸ Back

Posterior treatment effects by provider for different values of τ



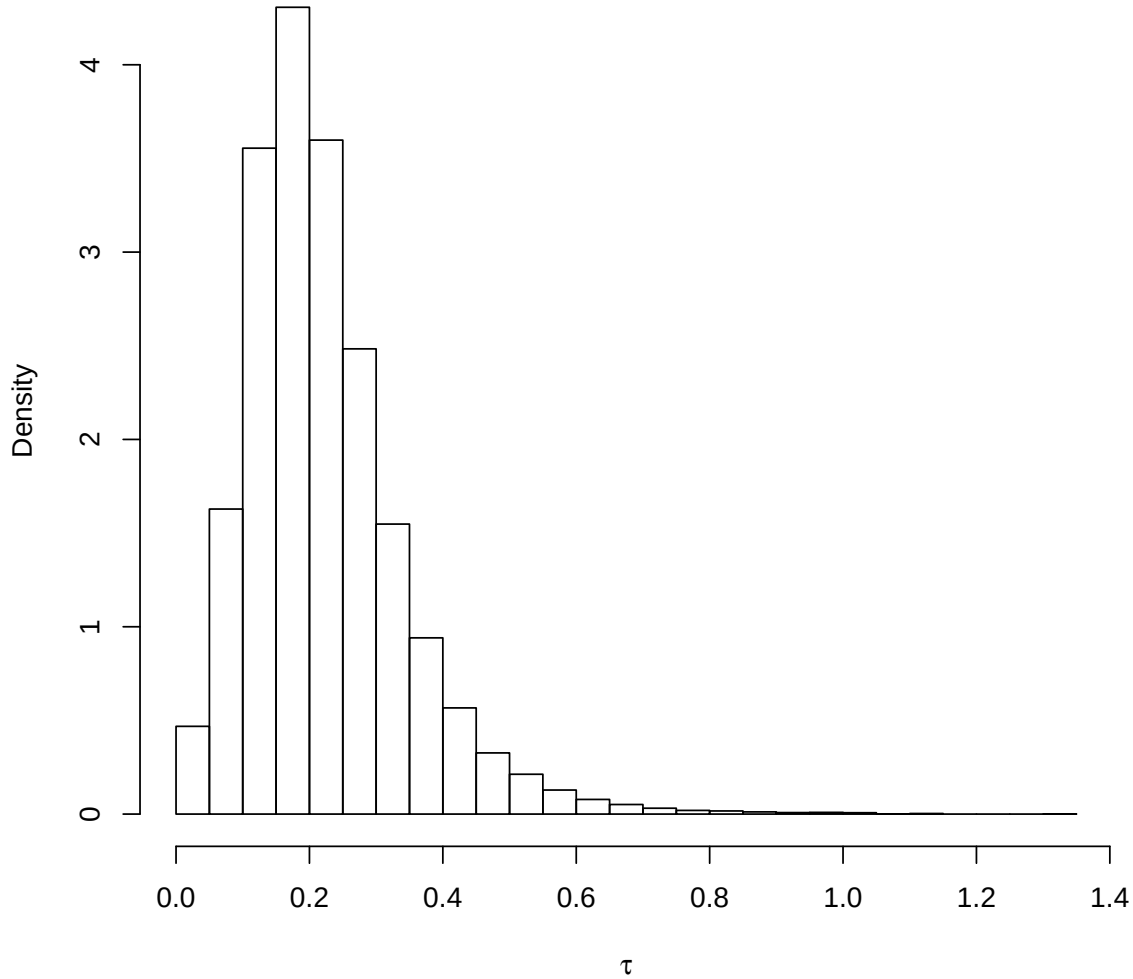
Back

Posterior standard errors by provider for different values of τ



Back

Posterior distribution of τ



Back

Posterior treatment effects and standard errors for different prior

	(1) BRAC	(2) Bridge	(3) YMCA	(4) MtM	(5) Omega	(6) Rising	(7) St. Child	(8) Stella M
Flat prior	0.080	0.329***	0.126	-0.037	0.242	0.210	-0.026	0.159
	(0.098)	(0.097)	(0.162)	(0.114)	(0.176)	(0.130)	(0.187)	(0.180)
Cauchy (0,25)	0.080	0.329***	0.127	-0.037	0.241	0.209	-0.025	0.160
	(0.098)	(0.097)	(0.162)	(0.114)	(0.176)	(0.130)	(0.186)	(0.180)
Half-normal	0.081	0.327***	0.127	-0.035	0.241	0.208	-0.023	0.160
	(0.097)	(0.097)	(0.161)	(0.114)	(0.175)	(0.128)	(0.186)	(0.178)
Half-t(4)	0.080	0.327***	0.127	-0.035	0.239	0.208	-0.022	0.160
	(0.098)	(0.097)	(0.160)	(0.114)	(0.175)	(0.128)	(0.184)	(0.178)

Back

No effect on total enrollment, but attendance increases

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: School level data (N = 175)				
Enrollment 2015/2016	298.45	264.11	34.34	34.18
	(169.74)	(109.91)	(21.00)	(20.28)
Enrollment 2016/2017	309.71	252.75	56.96	56.89
	(118.96)	(123.41)	(18.07)	(16.29)
15/16 to 16/17 enrollment change	11.55	-6.06	17.61	24.60
	(141.30)	(82.25)	(17.19)	(14.35)
Attendance % (spot check)	48.02	32.84	15.18	15.56
	(24.52)	(26.54)	(3.81)	(3.13)
% of students with disabilities	0.59	0.39	0.20	0.21
	(1.16)	(0.67)	(0.14)	(0.15)
Panel B: Student level data (N = 3,639)				
% enrolled in the same school	80.50	83.16	-2.66	0.71
	(39.63)	(37.43)	(3.66)	(2.06)
% enrolled in school	94.13	93.99	0.14	1.23
	(23.52)	(23.77)	(1.33)	(0.87)
Days missed, previous week	0.85	0.85	-0.00	-0.06
	(1.41)	(1.40)	(0.10)	(0.07)

▸ Without Bridge ▸ Back 1 ▸ Back 2

Without Bridge: No effect on total enrollment, but attendance increases

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: School level data (N = 136)				
Enrollment 2015/2016	263.25	247.94	15.31	15.31
	(97.38)	(92.57)	(16.06)	(14.83)
Enrollment 2016/2017	293.26	246.17	47.09**	46.68**
	(121.13)	(112.15)	(19.87)	(18.55)
15/16 to 16/17 enrollment change	29.45	-0.67	30.12**	30.19**
	(82.40)	(67.50)	(12.82)	(12.09)
Attendance % (spot check)	48.11	29.80	18.31***	18.58***
	(26.30)	(26.01)	(4.45)	(3.49)
% of students with disabilities	0.66	0.41	0.25	0.26
	(1.27)	(0.73)	(0.18)	(0.18)
Panel B: Student level data (N = 2,775)				
% enrolled in the same school	85.26	83.74	1.52	2.97**
	(35.47)	(36.91)	(2.34)	(1.46)
% enrolled in school	94.97	95.06	-0.09	0.71
	(21.86)	(21.67)	(1.11)	(0.69)
Days missed, previous week	0.68	0.86	-0.18*	-0.19***
	(1.25)	(1.43)	(0.09)	(0.07)

▸ Back 1 ▸ Back 2

No effect on total enrollment, but in constrained schools, enrollment went down

	(1) Δ enrollment	(2) % same school	(3) % in school	(4) Test scores
Constrained=0 × Treatment	5.30	4.04	1.64	0.15
	(1.11)	(1.39)	(0.73)	(0.034)
Constrained=1 × Treatment	-11.7	-12.8	0.070	0.35
	(6.47)	(7.74)	(4.11)	(0.11)
No. of obs.	1,635	3,625	3,485	3,490
Mean control (Unconstrained)	-0.75	82.09	93.38	0.13
Mean control (Constrained)	-7.73	84.38	94.81	-0.08
α_0 = Constrained - Unconstrained	-17.05	-16.79	-1.57	0.20
p-value ($H_0 : \alpha_0 = 0$)	0.01	0.03	0.71	0.07

▸ Without Bridge ▸ Back

Without Bridge: Enrollment goes up

	(1) Δ enrollment	(2) % same school	(3) % in school	(4) Test scores
Constrained=0 × Treatment	3.09***	3.94***	1.42*	0.12***
	(1.04)	(1.48)	(0.74)	(0.038)
Constrained=1 × Treatment	18.9**	-11.4	-10.1*	0.0076
	(8.55)	(7.03)	(5.32)	(0.12)
No. of obs.	1,256	2,773	2,636	2,641
Mean control (Unconstrained)	-0.54	82.63	93.93	0.09
Mean control (Constrained)	-9.96	79.49	100.00	-0.26
α_0 = Constrained - Unconstrained	15.84	-15.31	-11.55	-0.11
p-value ($H_0 : \alpha_0 = 0$)	0.07	0.04	0.04	0.36

Back

Lasso

1. Standardize variables
2. What mediators are correlated with learning the most (i.e., what explains learning differences?)
3. What mediators are correlated with the experiment the most (i.e., what did the experiment change?)

Each Lasso is estimated via:

$$\widehat{\beta}_t = \underset{\beta}{\text{argmin}} \, ||\mathbb{Y} - \mathbb{X}\beta||_2^2 \text{ subject to } ||\beta||_1 \leq t$$

or alternatively:

$$\widehat{\beta}_\lambda = \underset{\beta}{\text{argmin}} \, ||\mathbb{Y} - \mathbb{X}\beta||_2^2 + \lambda||\beta||_1$$

Back

By provider

	(1) BRAC	(2) Bridge	(3) YMCA	(4) MtM	(5) Omega	(6) Rising	(7) St. Child	(8) Stella M	(9) p-value
% teachers dismissed	-8.66	49.55***	13.92	-6.17	0.69	-0.77	-1.53	11.91	<0.001
	(6.46)	(7.18)	(11.13)	(6.74)	(11.88)	(8.97)	(12.90)	(13.01)	
% new teachers	38.12***	70.73***	47.11**	22.59*	20.57	35.91**	-9.52	35.78*	0.0060
	(11.15)	(13.10)	(18.67)	(11.92)	(20.17)	(15.21)	(26.30)	(21.03)	
School in session	0.16*	0.08	0.17	-0.13	0.22	0.05	0.27	0.27	0.026
	(0.08)	(0.09)	(0.13)	(0.10)	(0.15)	(0.11)	(0.16)	(0.16)	
Hours per week	0.80	7.60***	6.45***	3.93***	1.65	3.94**	-3.44	2.74	0.0020
	(1.42)	(1.55)	(2.46)	(1.41)	(2.52)	(1.91)	(3.29)	(2.72)	
Teacher attendance	13.02*	19.92***	17.76**	17.22***	24.81**	24.58***	28.27**	19.97**	0.26
	(6.97)	(6.27)	(8.76)	(6.24)	(10.07)	(8.48)	(12.27)	(9.46)	
Off-task (Classroom obs)	-14.46*	-13.64	-11.47	-13.07	-12.56	-11.27	-10.53	-12.07	0.77
	(8.36)	(8.43)	(10.40)	(8.32)	(10.46)	(9.61)	(11.12)	(10.74)	
Observations	40	45	8	12	38	10	24	8	

▸ Back (instructional time) ▸ Back (attendance) ▸ Back (time on task) ▸ Back (teachers)

More inputs and more and better teachers

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: School-level outcomes (N = 185)				
Number of teachers	9.62	7.02	2.60	2.61
	(2.82)	(3.12)	(0.44)	(0.37)
Pupil-teacher ratio (PTR)	32.20	39.95	-7.74	-7.82
	(12.29)	(18.27)	(2.31)	(2.12)
New teachers	4.81	1.77	3.03	3.01
	(2.56)	(2.03)	(0.34)	(0.35)
Teachers dismissed	3.35	2.17	1.18	1.16
	(3.82)	(2.64)	(0.48)	(0.47)
Panel B: Teacher-level outcomes (N = 1,167)				
Age in years	39.09	46.37	-7.28	-7.10
	(11.77)	(11.67)	(1.02)	(0.68)
Experience in years	10.59	15.79	-5.20	-5.26
	(9.20)	(10.77)	(0.76)	(0.51)
% has worked at a private school	47.12	37.50	9.62	10.20
	(49.95)	(48.46)	(3.76)	(2.42)
Test score in standard deviations	0.13	-0.01	0.14	0.14
	(1.02)	(0.99)	(0.07)	(0.06)
Panel C: Classroom observation (N = 185)				
Number of seats	20.64	20.58	0.06	0.58
	(13.33)	(13.57)	(2.21)	(1.90)
% with students sitting on the floor	2.41	4.23	-1.82	-1.51
	(15.43)	(20.26)	(2.94)	(2.61)
% with chalk	96.39	78.87	17.51	16.58
	(18.78)	(41.11)	(5.29)	(5.50)
% of students with textbooks	37.08	17.60	19.48	22.60
	(43.22)	(35.25)	(6.33)	(6.32)
% of students with pens/pencils	88.55	79.67	8.88	8.16
	(19.84)	(30.13)	(4.19)	(4.10)

▸ Without Bridge ▸ Back

Without Bridge: More inputs and more and better teachers

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: School-level outcomes (N = 140)				
Number of teachers	9.76	6.74	3.01***	3.01***
	(3.16)	(2.98)	(0.52)	(0.41)
Pupil-teacher ratio (PTR)	30.66	39.63	-8.97***	-8.97***
	(12.23)	(17.32)	(2.53)	(2.32)
New teachers	4.24	1.83	2.41***	2.41***
	(2.46)	(2.19)	(0.39)	(0.39)
Teachers dismissed	1.94	2.29	-0.34	-0.34
	(1.61)	(2.78)	(0.38)	(0.31)
Panel B: Teacher-level outcomes (N = 902)				
Age in years	40.18	46.21	-6.03***	-5.86***
	(12.07)	(11.83)	(1.21)	(0.78)
Experience in years	11.36	15.38	-4.01***	-4.05***
	(9.74)	(10.82)	(0.91)	(0.57)
% has worked at a private school	41.54	34.36	7.18*	7.48***
	(49.32)	(47.55)	(4.21)	(2.67)
Test score in standard deviations	0.07	-0.03	0.10	0.10
	(1.00)	(1.03)	(0.08)	(0.07)
Panel C: Classroom observation (N = 140)				
Number of seats	17.20	18.51	-1.31	-2.00
	(10.65)	(11.82)	(2.18)	(1.74)
% with students sitting on the floor	3.28	4.00	-0.72	0.00
	(17.96)	(19.79)	(3.62)	(3.11)
% with chalk	95.08	80.00	15.08**	13.04*
	(21.80)	(40.41)	(6.36)	(6.67)
% of students with textbooks	38.06	20.33	17.73**	21.04***
	(44.30)	(37.97)	(7.77)	(7.34)
% of students with pens/pencils	87.63	78.06	9.56*	7.71
	(20.99)	(31.60)	(5.17)	(5.11)

Back

Management improves

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
% school in session at spot check	92.47	83.70	8.78	8.66
	(26.53)	(37.14)	(4.75)	(4.52)
Instruction time (hrs/week)	17.84	14.69	3.15	3.17
	(4.84)	(4.04)	(0.66)	(0.65)
Intuitive score (out of 12)	4.08	4.03	0.04	0.02
	(1.35)	(1.38)	(0.20)	(0.19)
Time management score (out of 12)	5.60	5.69	-0.09	-0.10
	(1.21)	(1.35)	(0.19)	(0.19)
Principal's working time (hrs/week)	21.43	20.60	0.83	0.84
	(11.83)	(14.45)	(1.94)	(1.88)
% of principle's time spent on management	74.06	53.64	20.42	20.09
	(27.18)	(27.74)	(4.12)	(3.75)
Index of good practices (PCA)	0.41	-0.00	0.41	0.40
	(0.64)	(1.00)	(0.12)	(0.12)
Observations	92	93	185	185

▸ Without Bridge ▸ Go Back

Without Bridge: Management improves

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
% school in session	91.43	80.00	11.43*	11.43**
	(28.20)	(40.29)	(5.88)	(5.59)
Instruction time (hrs/week)	19.06	16.40	2.66***	2.66***
	(5.44)	(4.59)	(0.85)	(0.79)
Intuitive score (out of 12)	4.03	3.92	0.11	0.09
	(1.44)	(1.37)	(0.24)	(0.23)
Time management score (out of 12)	5.60	5.68	-0.08	-0.09
	(1.22)	(1.44)	(0.23)	(0.23)
Principal's working time (hrs/week)	21.45	20.98	0.48	0.48
	(10.73)	(14.37)	(2.14)	(2.00)
% of time spent on management	69.41	52.70	16.72***	17.03***
	(25.89)	(27.76)	(4.62)	(4.16)
Index of good practices (PCA)	0.36	0.04	0.32**	0.32**
	(0.66)	(0.97)	(0.14)	(0.12)
Observations	92	93	140	140

▸ Go Back

Teachers attendance and time on-task increases

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: Spot checks (N = 185)				
% on schools campus	60.32	40.38	19.94	19.79
	(23.10)	(25.20)	(3.56)	(3.48)
% in classroom	47.02	31.42	15.60	15.37
	(26.65)	(25.04)	(3.80)	(3.62)
Panel B: Student reports (N = 185)				
Teacher missed school previous week (%)	17.72	25.12	-7.41	-7.53
	(10.79)	(14.93)	(1.92)	(1.95)
Teacher never hits students (%)	54.73	48.20	6.52	6.59
	(18.76)	(17.07)	(2.64)	(2.53)
Teacher helps outside the classroom (%)	50.02	46.59	3.42	3.56
	(18.24)	(18.01)	(2.67)	(2.28)
Panel C: Classroom observations (N = 185)				
Instruction (active + passive) (% of class time)	49.68	35.00	14.68	14.51
	(32.22)	(37.08)	(5.11)	(4.70)
Classroom management (% class time)	19.03	8.70	10.34	10.25
	(20.96)	(14.00)	(2.62)	(2.73)
Teacher off-task (% class time)	31.29	56.30	-25.01	-24.77
	(37.71)	(42.55)	(5.91)	(5.48)
Student off-task (% class time)	50.41	47.14	3.27	2.94
	(33.51)	(38.43)	(5.30)	(4.59)

▸ Without Bridge ▸ Go Back ▸ Fixed pool of teachers

Teachers attendance and time on-task increases

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: Spot checks (N = 140)				
% on schools campus	59.42	38.68	20.74***	20.74***
	(24.29)	(25.92)	(4.25)	(4.20)
% in classroom	44.52	29.06	15.46***	15.46***
	(26.70)	(25.59)	(4.42)	(4.20)
Panel B: Student reports (N = 140)				
Teacher missed school previous week (%)	16.25	24.64	-8.39***	-8.39***
	(10.95)	(14.65)	(2.19)	(2.26)
Teacher never hits students (%)	52.59	45.07	7.52**	7.52**
	(17.96)	(16.48)	(2.91)	(2.94)
Teacher helps outside the classroom (%)	50.83	47.61	3.22	3.22
	(18.87)	(18.76)	(3.18)	(2.76)
Panel C: Classroom observations (N = 140)				
Instruction (active + passive) (% of class time)	48.57	30.71	17.86***	17.86***
	(33.11)	(35.85)	(5.83)	(5.45)
Classroom management (% class time)	18.57	9.86	8.71***	8.71***
	(21.35)	(15.37)	(3.14)	(3.24)
Teacher off-task (% class time)	32.86	59.43	-26.57***	-26.57***
	(38.57)	(42.63)	(6.87)	(6.35)
Student off-task (% class time)	47.96	45.80	2.16	2.16
	(33.99)	(38.39)	(6.13)	(5.41)

▸ Go Back ▸ Fixed pool of teachers

Lee bounds

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)	(5) 90% CI Lee bounds
Panel A: Spot check (N = 929)					
% on schools campus	68.15	52.40	15.75	14.17	2.51
	(46.64)	(50.00)	(4.45)	(3.75)	28.11
% in classroom	50.96	41.05	9.91	9.96	-1.34
	(50.04)	(49.25)	(4.78)	(3.86)	24.44
B: Classroom observation (N = 143)					
Active instruction (% class time)	38.12	30.13	7.98	7.62	-4.75
	(28.93)	(32.11)	(4.86)	(4.75)	19.92
Passive instruction (% class time)	16.24	12.80	3.44	4.72	-4.93
	(17.18)	(19.83)	(2.95)	(3.23)	9.62
Classroom management (% class time)	20.82	10.67	10.16	10.33	0.77
	(21.06)	(14.83)	(2.85)	(3.32)	16.99
Teacher off-task (% class time)	24.82	46.40	-21.58	-22.66	-40.24
	(32.65)	(41.09)	(5.92)	(6.26)	-10.32
Student off-task (% class time)	55.06	57.60	-2.54	-5.19	-16.05
	(31.23)	(34.87)	(5.26)	(4.88)	12.63
Panel C: Inputs (N = 143)					
Number of seats	20.64	20.58	0.06	0.58	-7.22
	(13.33)	(13.57)	(2.21)	(1.90)	5.36
% with students sitting on the floor	2.41	4.23	-1.82	-1.51	-7.48
	(15.43)	(20.26)	(2.94)	(2.61)	2.76
% with chalk	96.39	78.87	17.51	16.58	9.47
	(18.78)	(41.11)	(5.29)	(5.50)	27.85
% of students with textbooks	37.08	17.60	19.48	22.60	-1.21
	(43.22)	(35.25)	(6.33)	(6.32)	34.87
% of students with pens/pencils	88.55	79.67	8.88	8.16	1.36
	(19.84)	(30.13)	(4.19)	(4.10)	20.98

Without Bridge: Lee bounds

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)	(5) 90% CI Lee bounds
Panel A: Spot check (N = 740)					
% on schools campus	67.88	50.76	17.12***	14.41***	7.83
	(46.75)	(50.07)	(5.25)	(4.15)	32.16
% in classroom	49.39	38.60	10.79*	9.20**	-1.47
	(50.06)	(48.76)	(5.67)	(4.41)	22.86
B: Classroom observation (N = 102)					
Active instruction (% class time)	39.05	27.22	11.83**	10.98*	-4.30
	(30.31)	(31.47)	(5.74)	(5.69)	27.41
Passive instruction (% class time)	14.92	12.59	2.33	3.14	-7.89
	(16.55)	(21.03)	(3.54)	(4.10)	9.92
Classroom management (% class time)	20.63	12.78	7.86**	7.65*	-3.95
	(21.54)	(16.42)	(3.52)	(4.11)	16.77
Teacher off-task (% class time)	25.40	47.41	-22.01***	-21.76***	-44.55
	(33.01)	(41.49)	(7.01)	(7.67)	-7.81
Student off-task (% class time)	53.17	59.07	-5.90	-8.24	-22.73
	(31.77)	(33.66)	(6.08)	(6.01)	12.32
Panel C: Inputs (N = 102)					
Number of seats	17.20	18.51	-1.31	-2.00	-8.10
	(10.65)	(11.82)	(2.18)	(1.74)	4.02
% with students sitting on the floor	3.28	4.00	-0.72	0.00	-7.74
	(17.96)	(19.79)	(3.62)	(3.11)	5.30
% with chalk	95.08	80.00	15.08**	13.04*	4.99
	(21.80)	(40.41)	(6.36)	(6.67)	27.73
% of students with textbooks	38.06	20.33	17.73**	21.04***	-8.17
	(44.30)	(37.97)	(7.77)	(7.34)	37.33
% of students with pens/pencils	87.63	78.06	9.56*	7.71	-0.07
	(20.99)	(31.60)	(5.17)	(5.11)	24.12

Students and parents like PPP schools more

	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: Household behavior (N = 1,115)				
% satisfied with school	74.90	67.41	7.49	7.51
	(19.18)	(23.99)	(3.20)	(3.23)
% paying any fees	48.08	73.59	-25.50	-25.74
	(50.00)	(44.13)	(4.73)	(3.27)
Fees (USD/year)	5.68	8.06	-2.38	-2.95
	(10.16)	(9.73)	(0.97)	(0.62)
Expenditure (USD/year)	65.57	73.53	-7.95	-6.60
	(74.84)	(79.32)	(6.95)	(4.11)
Engagement index (PCA)	-0.11	-0.09	-0.03	-0.03
	(0.84)	(0.91)	(0.07)	(0.06)
Panel B: Student attitudes (N = 3,492)				
School is fun	0.58	0.53	0.05	0.05
	(0.49)	(0.50)	(0.02)	(0.02)
I use what I'm learning outside of school	0.52	0.49	0.04	0.04
	(0.50)	(0.50)	(0.02)	(0.02)
If I work hard, I will succeed.	0.60	0.55	0.05	0.04
	(0.49)	(0.50)	(0.03)	(0.02)
Elections are the best way to choose a president	0.90	0.88	0.03	0.03
	(0.30)	(0.33)	(0.01)	(0.01)
Boys are smarter than girls	0.69	0.69	0.00	0.01
	(0.46)	(0.46)	(0.02)	(0.01)
Some tribes in Liberia are bad	0.76	0.79	-0.03	-0.03
	(0.43)	(0.41)	(0.02)	(0.01)

▸ Without Bridge ▸ Back

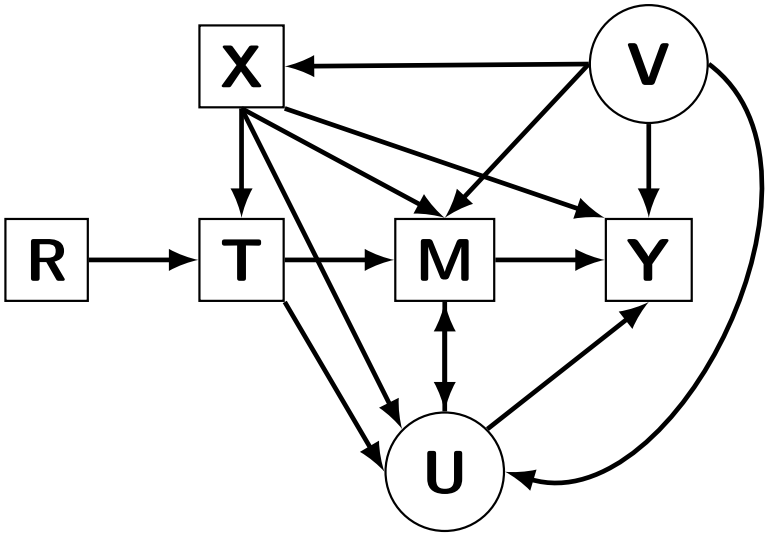
Without Bridge: Students and parents like PPP schools more

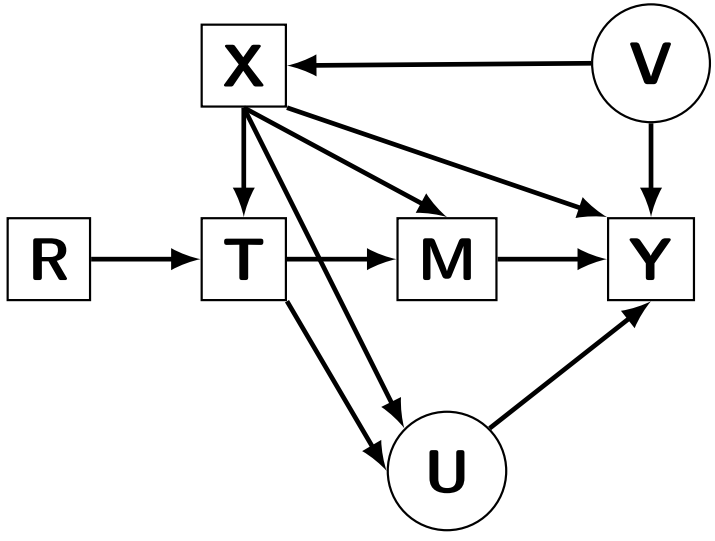
	(1) Treatment	(2) Control	(3) Difference	(4) Difference (F.E)
Panel A: Household behavior (N = 817)				
% satisfied with school	75.04	69.53	5.51	5.51
	(18.78)	(23.96)	(3.64)	(3.73)
% paying any fees	57.41	77.46	-20.04***	-20.36***
	(49.50)	(41.84)	(5.50)	(3.67)
Fees (USD/year)	5.69	8.01	-2.32**	-2.34***
	(9.61)	(9.27)	(1.00)	(0.68)
Expenditure (USD/year)	65.42	68.04	-2.62	-0.37
	(75.46)	(70.54)	(6.40)	(4.78)
Engagement index (PCA)	-0.12	-0.08	-0.04	-0.06
	(0.88)	(0.92)	(0.08)	(0.06)
Panel B: Student attitudes (N = 2,643)				
School is fun	0.57	0.53	0.04	0.04**
	(0.50)	(0.50)	(0.03)	(0.02)
I use what I'm learning outside of school	0.52	0.49	0.04	0.05***
	(0.50)	(0.50)	(0.03)	(0.02)
If I work hard, I will succeed.	0.57	0.55	0.02	0.03
	(0.50)	(0.50)	(0.03)	(0.02)
Elections are the best way to choose a president	0.90	0.88	0.02	0.02*
	(0.30)	(0.33)	(0.02)	(0.01)
Boys are smarter than girls	0.71	0.70	0.01	0.02
	(0.45)	(0.46)	(0.02)	(0.02)
Some tribes in Liberia are bad	0.73	0.77	-0.05*	-0.03*
	(0.45)	(0.42)	(0.02)	(0.02)

Back

Decompose the treatment effect - Mediation analysis

Causal relationships under different models





Under assumption sequential ignorability

Note: Based on Figure 1 in Heckman and Pinto (2015).

▸ Back

Decompose the treatment effect - Mediation analysis

$$M_{isg} = \alpha_g + \beta_6 treat_g + \gamma_6 X_i + \delta_6 Z_s + u_i \quad (6)$$

$$Y_{isg} = \alpha_g + \beta_7 treat_g + \gamma_7 X_i + \delta_7 Z_s + \theta_7 M_{is} + \varepsilon_i \quad (7)$$

Back

Key assumption

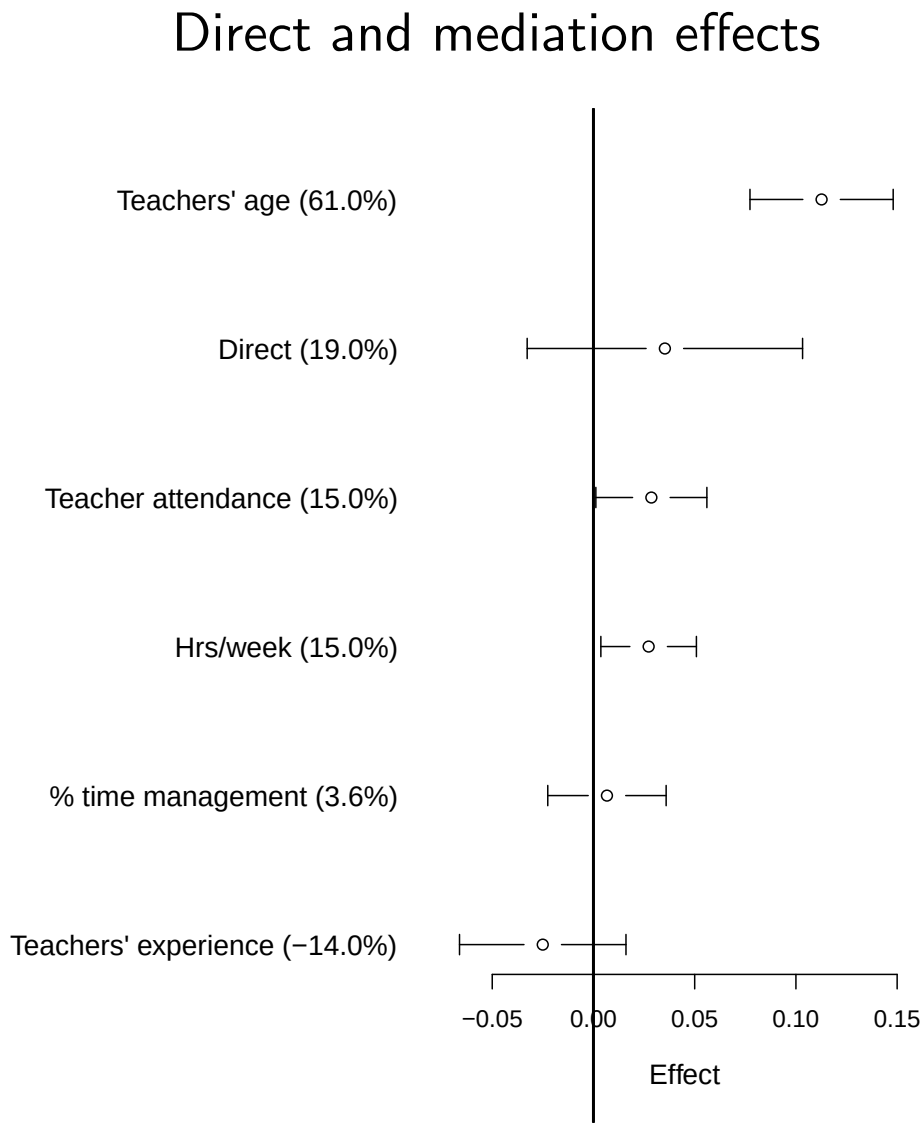
Sequential ignorability (Imai, Keele, & Yamamoto, 2010)]

$$Y_i(t', m), M_i(t) \perp\!\!\!\perp T_i | X_i = x \tag{8}$$

$$Y_i(t', m) \perp\!\!\!\perp M_i(t) | X_i = x, T_i = t \tag{9}$$

Back

Material inputs don't matter, teachers do (and so does teacher attendance)



Back

1. How do we allow for differences in context? Adjust for baseline differences

	(1) BRAC	(2) Bridge	(3) LIYONET	(4) MtM	(5) Omega	(6) Rising	(7) St. Child	(8) Stella M	(9) p-value equality
Students	31.94	156.19	-23.03	35.49	-0.83	31.09	-19.16	-22.53	.00092
	(27.00)	(25.48)	(49.01)	(27.69)	(53.66)	(34.74)	(59.97)	(59.97)	
Teachers	1.23	2.72	1.42	1.70	1.16	0.59	1.13	0.76	.66
	(0.70)	(0.66)	(1.28)	(0.72)	(1.40)	(0.90)	(1.56)	(1.56)	
PTR	-4.57	5.77	-8.47	-5.45	-6.02	2.34	-10.62	-7.29	.079
	(3.27)	(3.09)	(5.94)	(3.36)	(6.50)	(4.21)	(7.27)	(7.27)	
Latrine/Toilet	0.18	0.28	0.26	0.25	0.23	0.22	0.06	0.18	.96
	(0.08)	(0.07)	(0.14)	(0.08)	(0.16)	(0.10)	(0.17)	(0.17)	
Solid classrooms	0.63	2.81	2.64	-0.11	1.85	1.59	-1.95	1.30	.055
	(0.75)	(0.71)	(1.36)	(0.77)	(1.49)	(0.97)	(1.67)	(1.67)	
Solid building	0.28	0.22	0.19	0.09	0.26	0.19	0.23	0.23	.84
	(0.08)	(0.07)	(0.14)	(0.08)	(0.15)	(0.10)	(0.17)	(0.17)	
Nearest paved road (KM)	-9.25	-10.86	-7.13	-8.22	-4.47	-7.13	-4.56	-7.79	.78
	(2.03)	(1.91)	(3.67)	(2.08)	(4.01)	(2.60)	(4.48)	(4.48)	

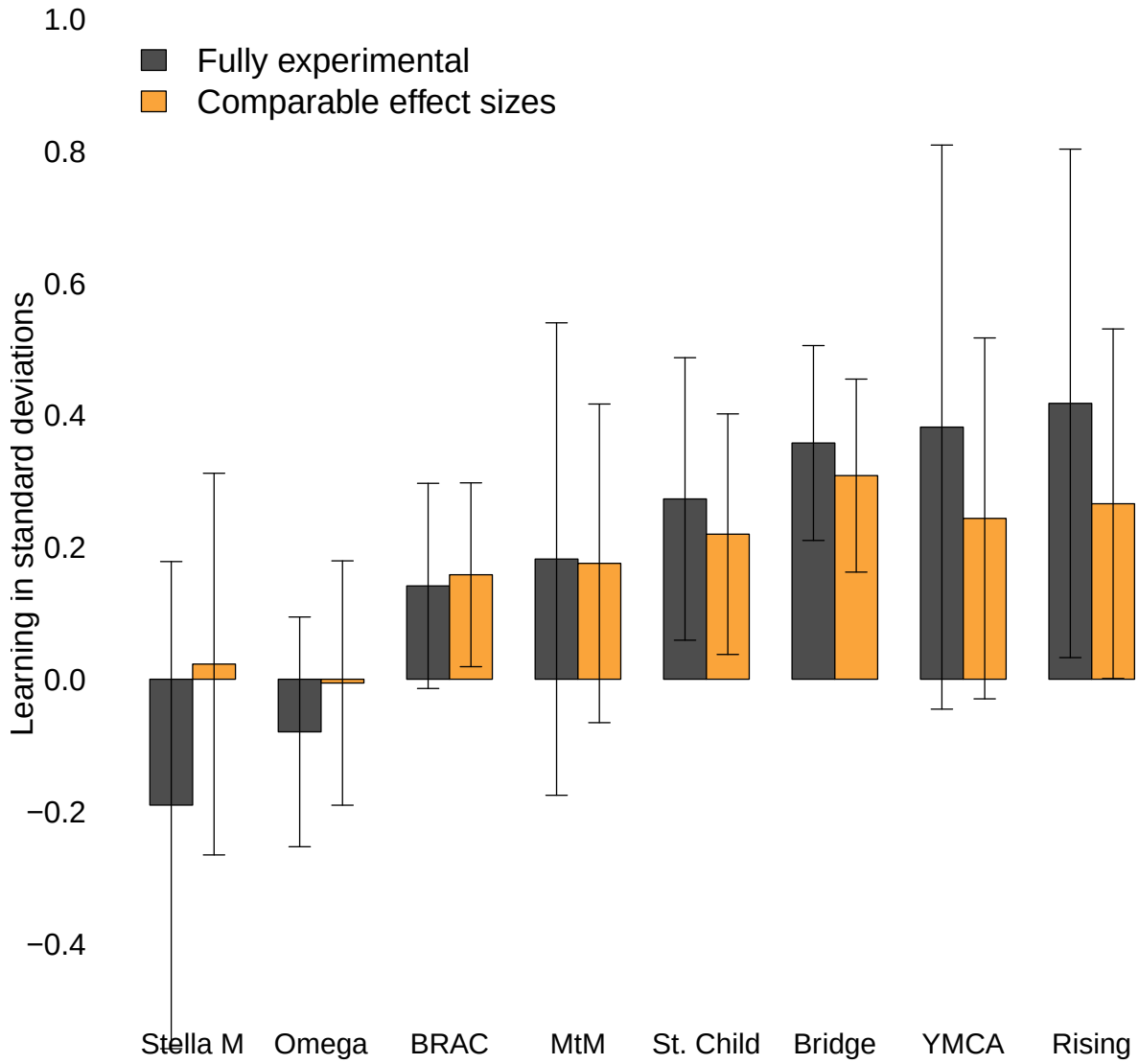
▸ Back ▸ Back2

2. How do we overcome small samples?

- Different providers: Same program
- Bayesian hierarchical model ala Rubin (1981)
- "Pool power" across providers
- Final estimate: Weighted average of providers' ITT and average ITT
  - Proportions depend on provider's sample size

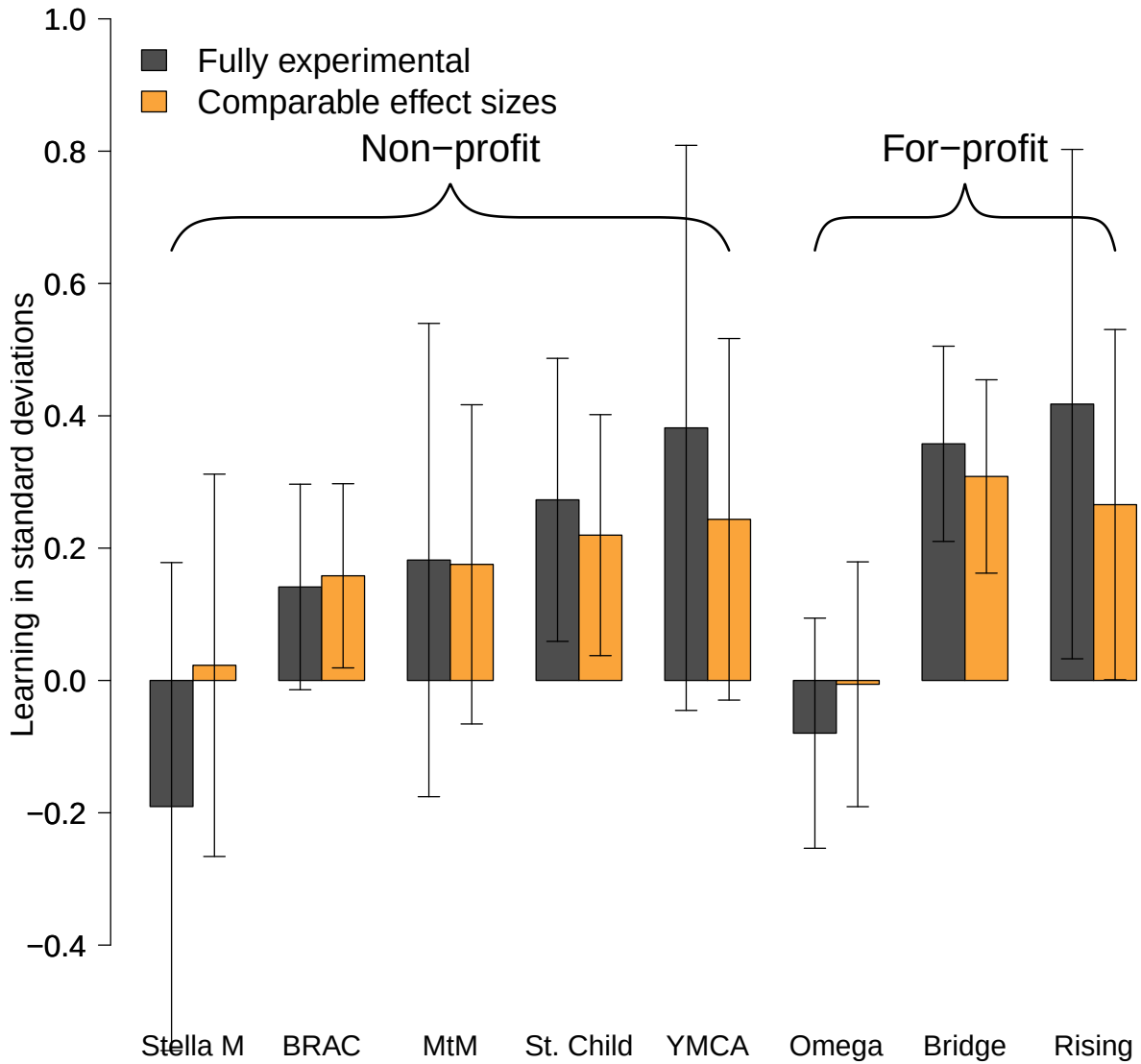
Back Math

Learning outcomes by provider



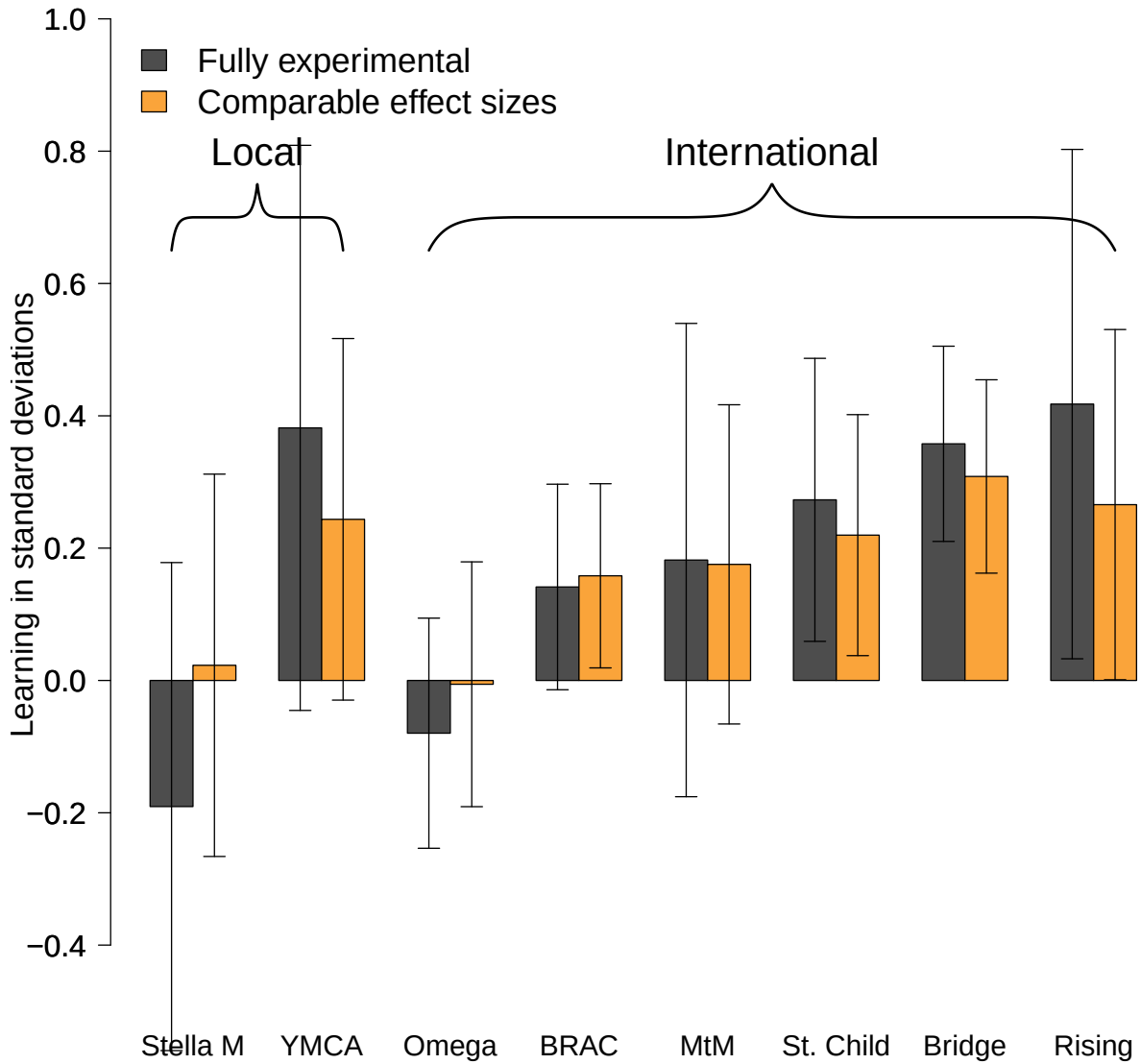
▸ Full comparison ▸ ToT ▸ Back

Learning outcomes by provider



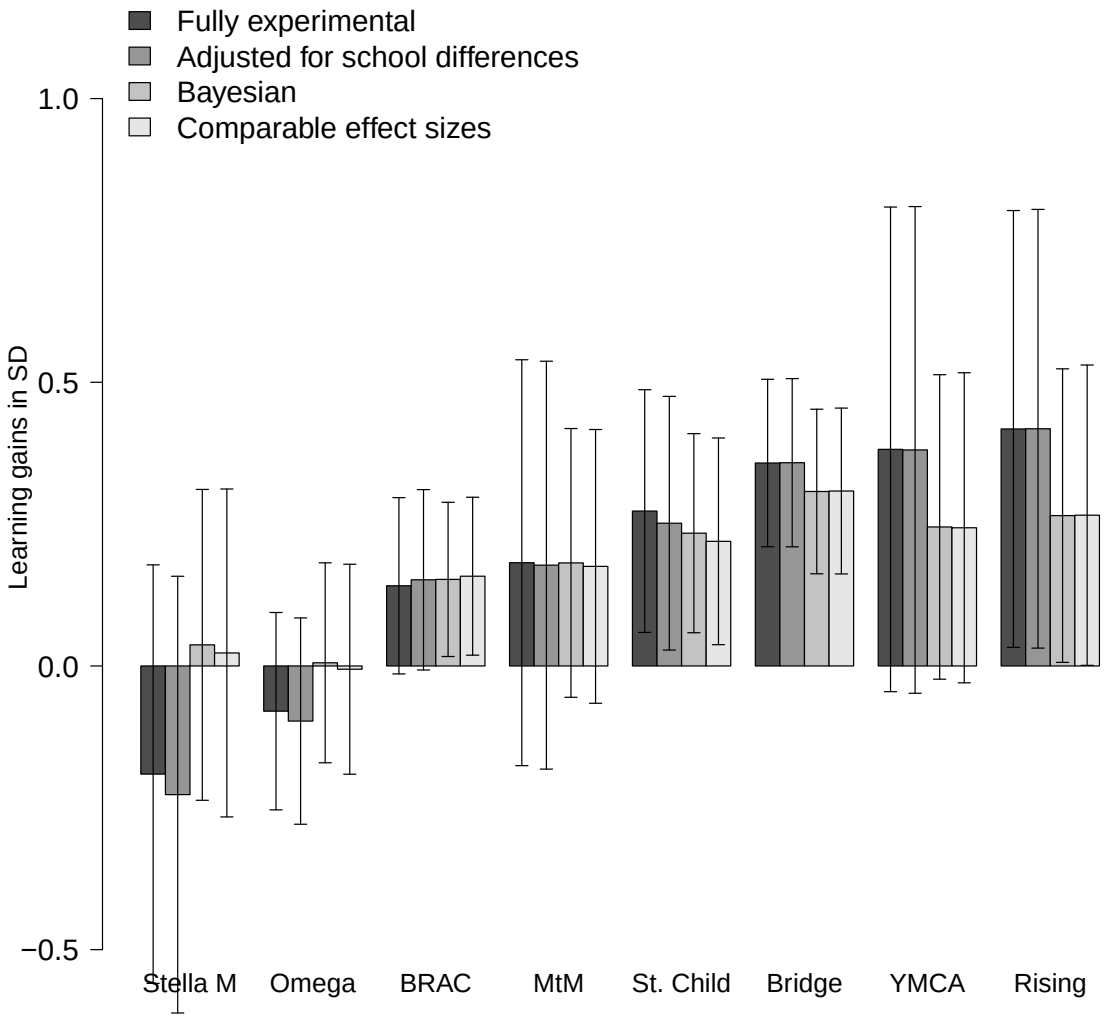
▸ Full comparison ▸ ToT ▸ Back

Learning outcomes by provider



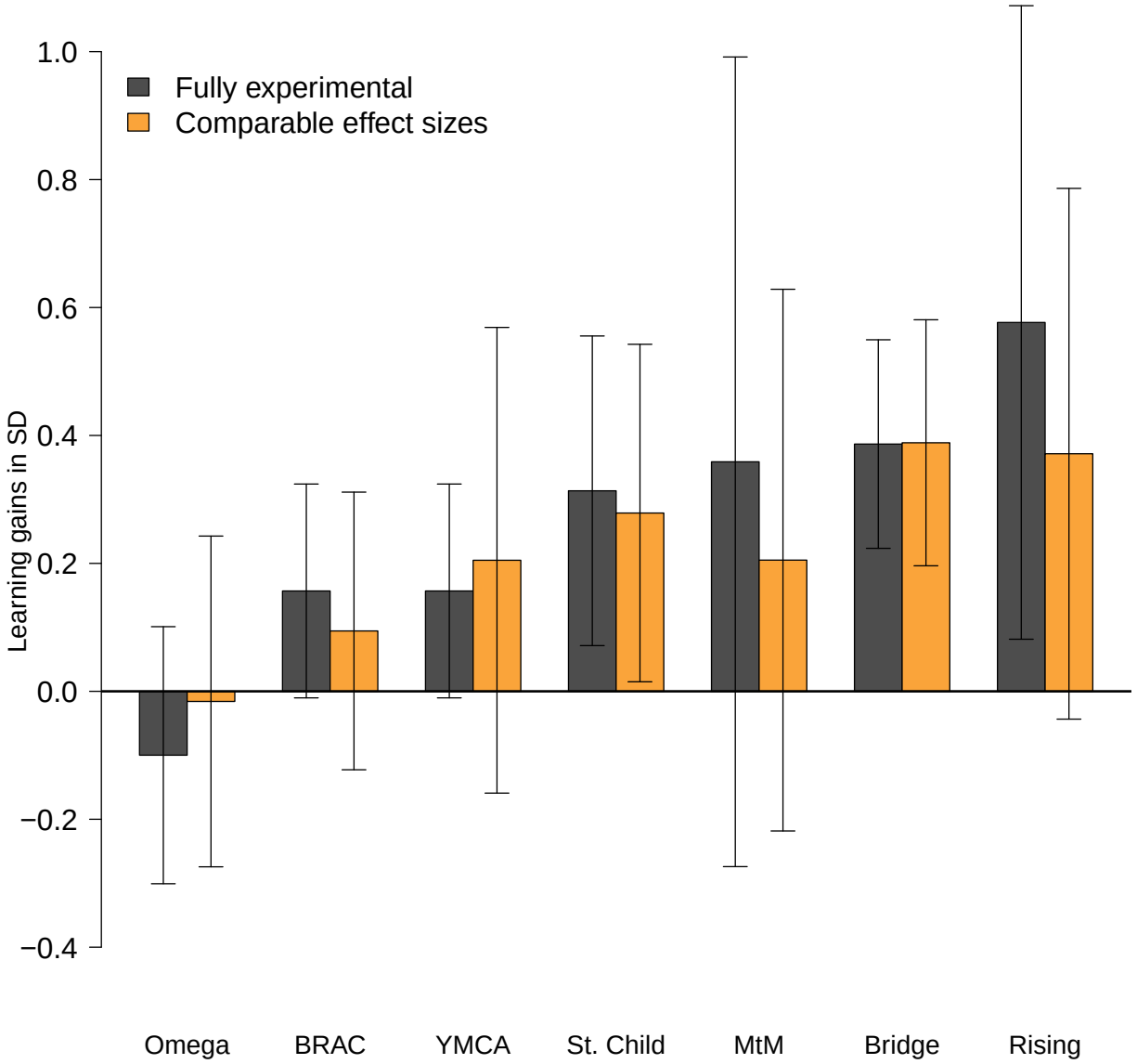
▸ Full comparison ▸ ToT ▸ Back

Learning outcomes by provider



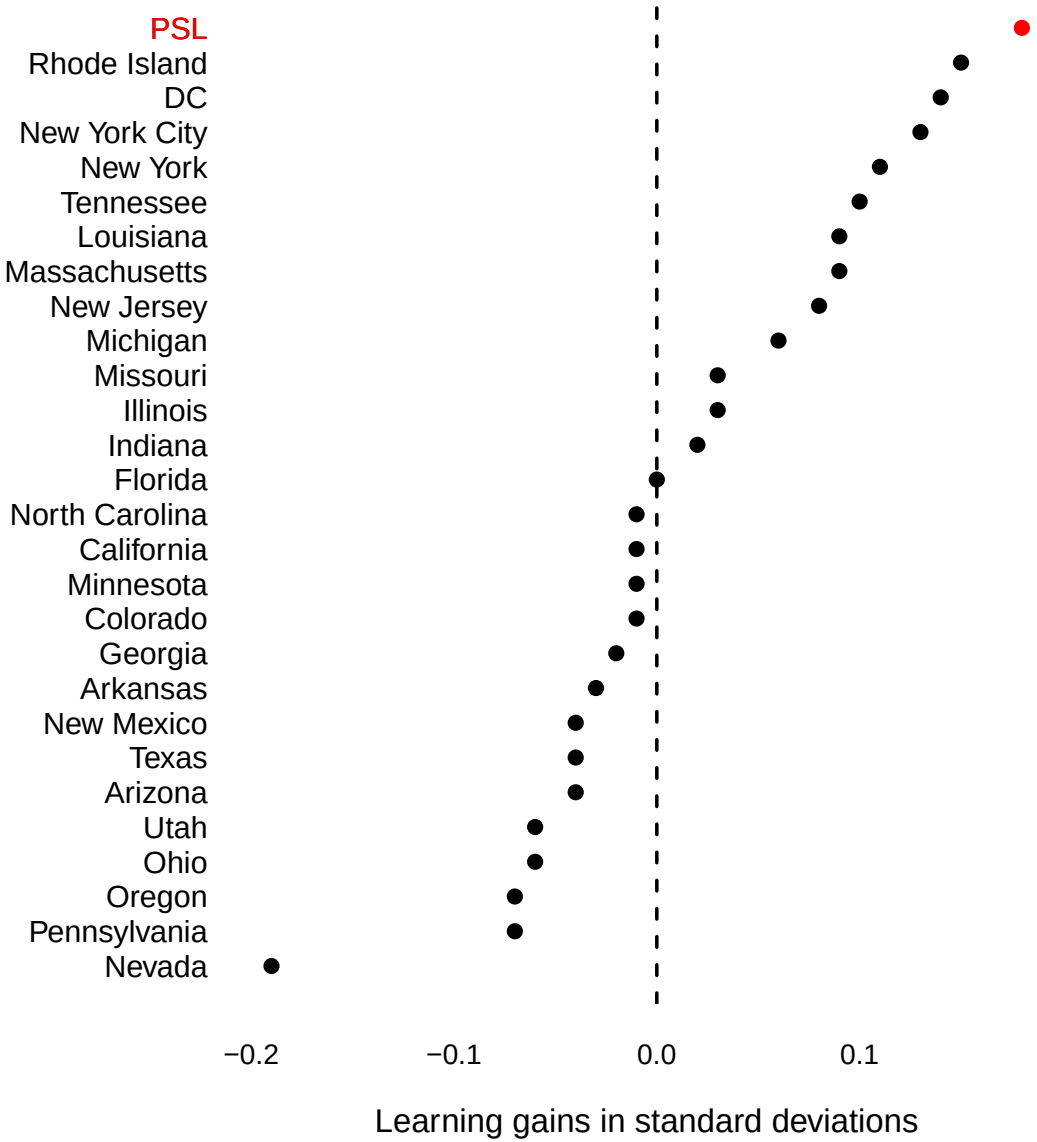
▸ Back 1 ▸ Back 2 ▸ Back 3

Treatment on the treated



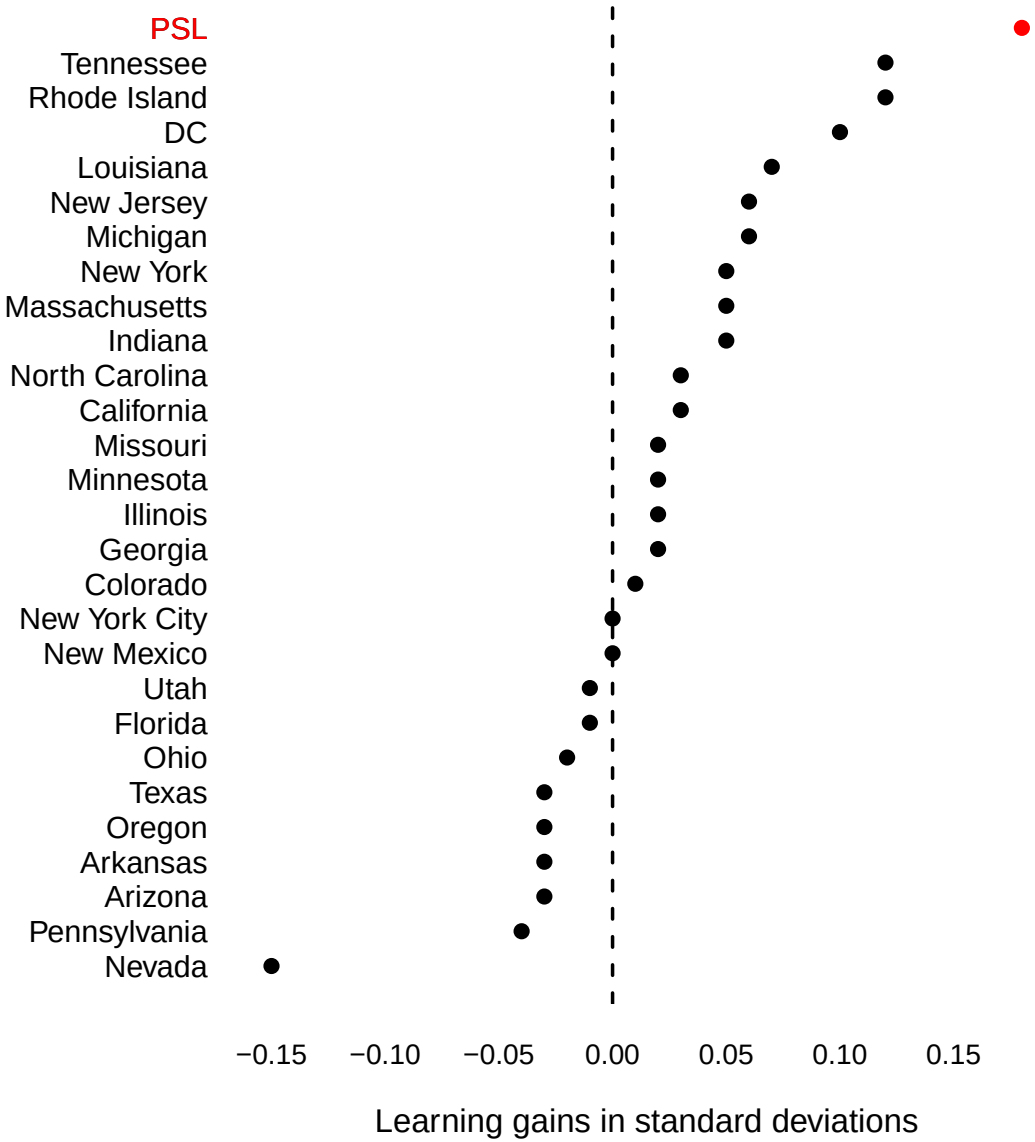
Back

Math

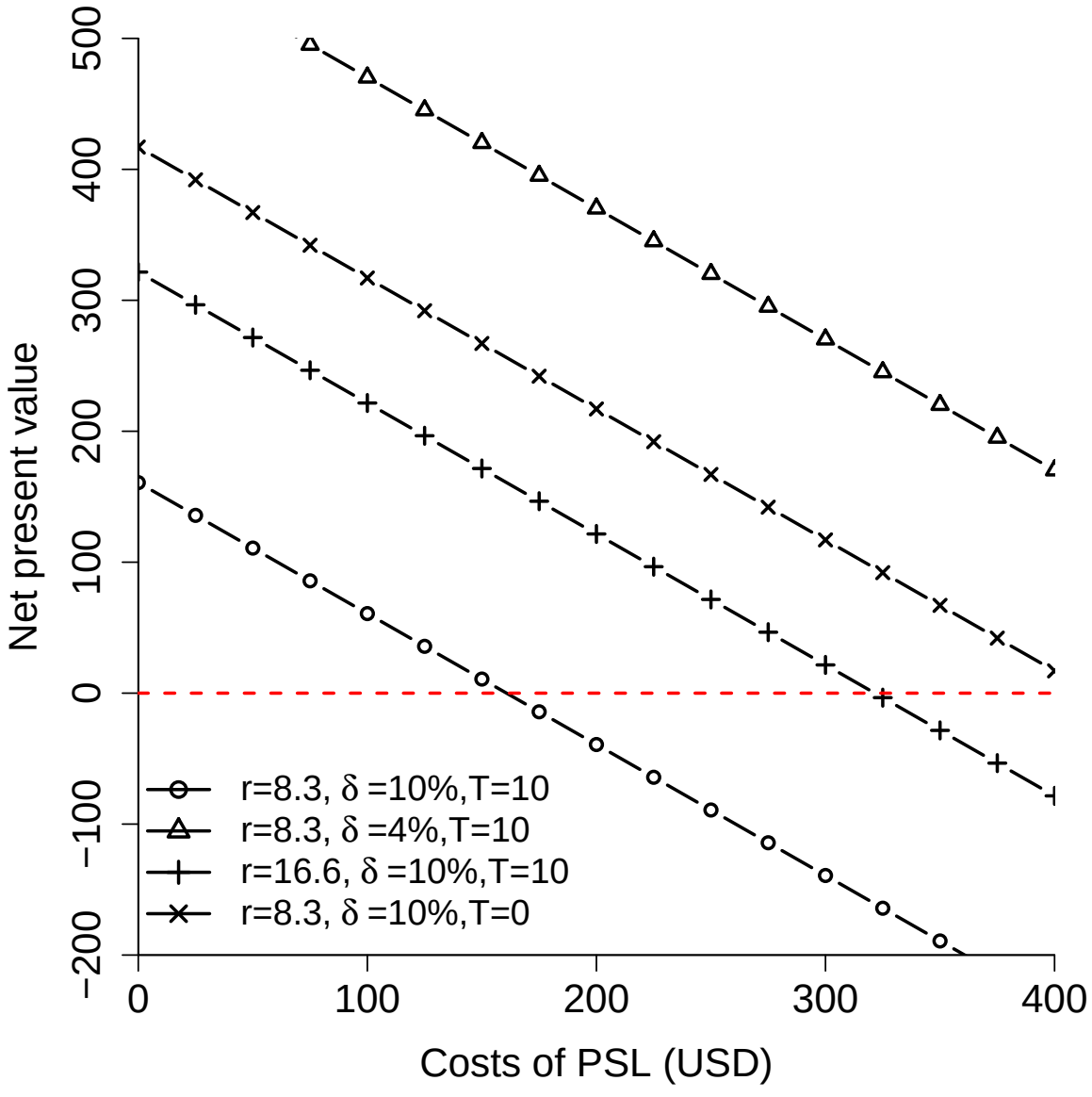

PSL
Rhode Island
DC
New York City
New York
Tennessee
Louisiana
Massachusetts
New Jersey
Michigan
Missouri
Illinois
Indiana
Florida
North Carolina
California
Minnesota
Colorado
Georgia
Arkansas
New Mexico
Texas
Arizona
Utah
Ohio
Oregon
Pennsylvania
Nevada
−0.2
−0.1
0.0
0.1
Learning gains in standard deviations

Back

English



Back


Net present value
500
400
300
200
100
0
−100
−200
0
100
200
300
400
Costs of PSL (USD)
r=8.3, δ =10%,T=10
r=8.3, δ =4%,T=10
r=16.6, δ =10%,T=10
r=8.3, δ =10%,T=0

Back

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