BREAD-IGC-ISI Summer School in Development Economics (July 2012)

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Lecture 6 (Education)

Lecture Plan

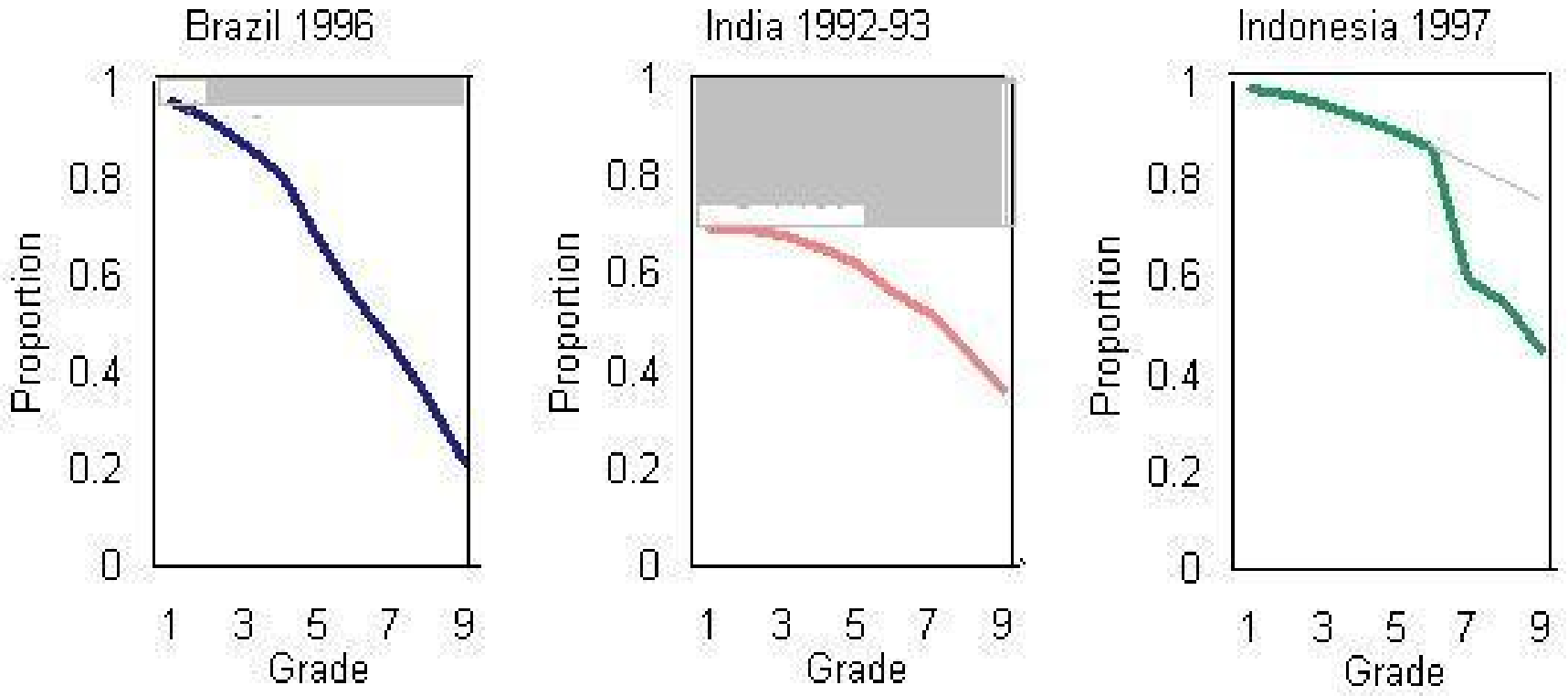
- **Education in Development Economics (20)**
- Teacher Performance Pay (30)
- School Grants (15)
- Tracking and Peer Effects (15)
- Other papers on reading list (10)

Returns to Education

- Returns to Education – Macro
  - Mankiw, Romer, and Weil (1992)
  - Barro (1991); Benhabib & Spiegel (1994)
  - Bils & Klenow (2000)
  - Krueger & Lindahl (2001)
  - Hanushek & Woessman (2008, 2010)
- Returns to Education – Micro
  - Angrist & Krueger (1991); Ashenfelter & Krueger (1994); Card (1999, 2001)
  - Rosenzweig (1995); Foster & Rosenzweig (1996)
  - Duflo (2001)

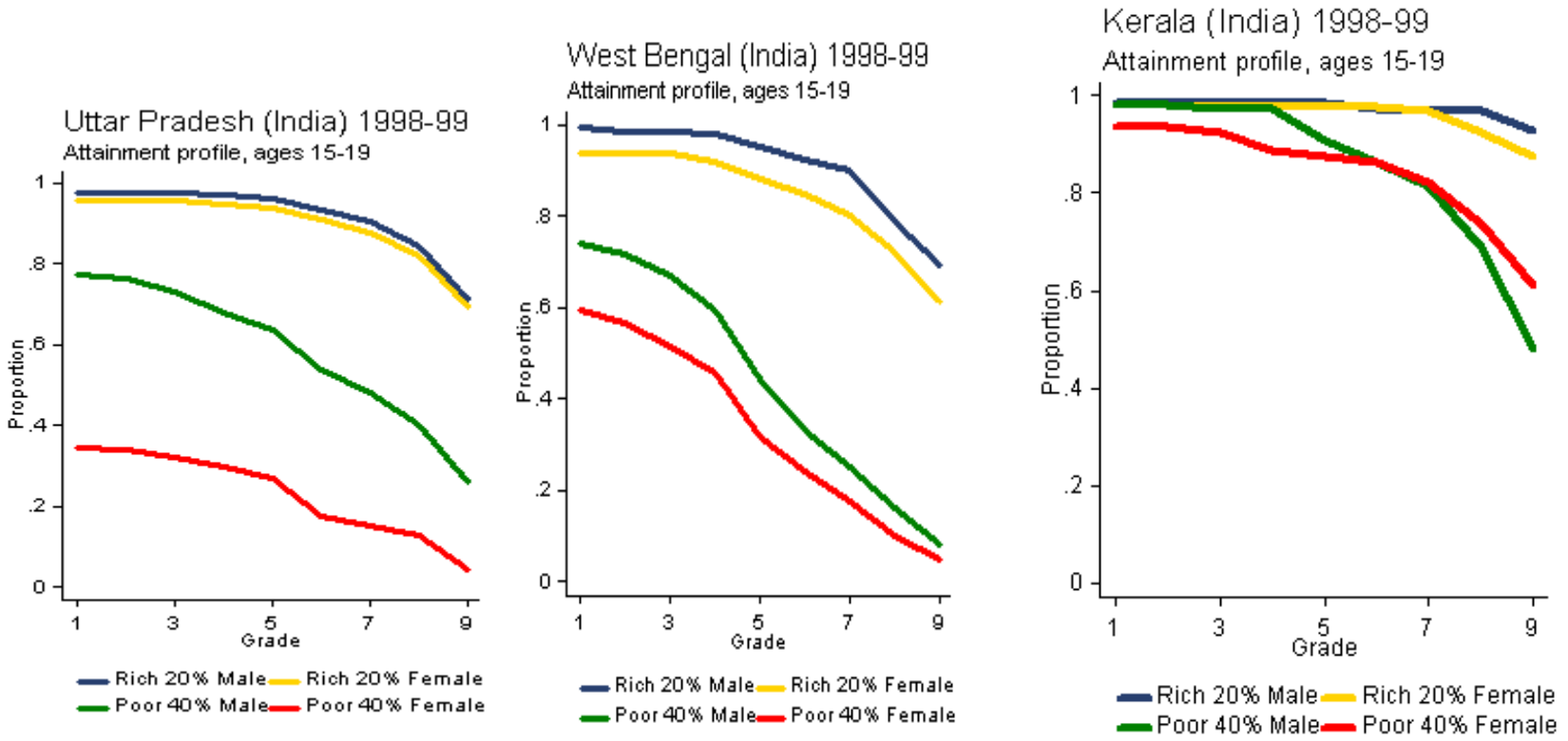
School Completion Rates

Proportion of 15 to 19 year olds who have completed each grade



Source: Pritchett Copenhagen Consensus Paper (2004)

School Completion by Income/Gender



- These numbers are dated.
- You can create your own graphs of this sort from household survey data (including the DLHS, Pratham ASER, etc)

Education Quality May be an Even Bigger Challenge

- Close to 60% of children aged 6-14 in India could not read a paragraph of 2nd grade difficulty (ASER Reports)
  - Over 65% could not do a simple division problem (3 digits by 1 digit)
  - Also see Das & Zajonc (2010)

- Data from internationally comparable assessments such as TIMSS and PISA shows the quality differential across countries in learning outcomes to be massive (many developing countries are behind by over 3 standard deviations of the OECD distribution)

- These are HUGE differences in quality, and if anything, they understate the magnitude of the differences because of the truncation of the left hand side of the student distribution in developing countries

Benefits/Costs of Education

- Private benefits of education could include:

  -- Human capital (higher productivity and wages)

  -- Education as a signal of ability (also higher wages)

  -- Education as consumption (reading Shakespeare)

- Social benefits **could** include labor productivity spillovers; complementarity with technology adoption; a "better" functioning democracy, less crime, better child health

- Costs: Direct costs; opportunity cost of time

Economics of Education

- The economics of education studies several types of economic questions and is a very active area of research
- Thinking like a labor economist
  - Demand for education, returns to education, "general" vs. "vocational" education, education vs. on the job training, human capital vs. screening
- Thinking like a public economist
  - The case for public intervention, how much intervention, forms of interventions, consequences of different forms of interventions, trade offs, financing public involvement, level of government (federalism)
- Thinking like an organizational economist/economist of the firm
  - Education production function, choice of quantity and quality of inputs, teacher compensation structure, accountability, professional development, organization of production, extent of competition, regulation
- Other questions in economics of education
  - Macro, development, social policy, political economy
- All these questions are magnified for a developing country!

Why Public Intervention in Education?

- According to standard theory of individual optimization:
- Individuals will trade off the costs and benefits of an additional year of education and will choose to get educated till the point where benefits equal costs
- Then, why should the government get involved in education policy?
- Why might outcomes be sub-optimal if left to market forces alone? Where is the market failure?
- Sub-optimal consumption
- Sub-optimal production

Market Failures and Sub-Optimal Demand

- Imperfect credit markets
  - Lack of collateral, cannot borrow to pay upfront costs
- Parents make choices for children
  - Different utility functions (especially with multiple children)
  - May not fully internalize the returns to education for children
- High Discount Rates
  - Risk/uncertainty in the return on investment
  - Mortality risk (duration of payoff period)
- Social externalities
  - Productivity, civic culture
- Imperfect information on returns to education
  - Lack of both formal knowledge and of role models (learning by doing)
  - Role of poor initial conditions in determining cognitive capacity, which in turn impacts the returns to education

Sub-Optimal Production

- Access failures
  - Fixed costs of production, may require minimum scale to operate
  - Collective action and coordination problems

- Sub-optimal mix of inputs in production (assume public production)
  - What is the optimal combination of various factors of production (teachers, buildings, other materials) in 'producing' education?
  - Why might these be sub-optimally chosen?
    - Lack of knowledge of the underlying production function
    - Standard set of inputs applied without local customization
    - Political economy considerations

- Sub-optimal use of given inputs (for any mix)
  - Incentives!
  - Compare a firm facing market conditions with a typical school
  - The exit/voice framework (Hirschman 1971)
    - Lack of "voice" for the weakest sections of society
    - Collective action problems under "voice"

- Note that not all of these are "market failures" – but reflect reasons for why outcomes may be sub-optimal (as defined by social planner)

Improving education

- Improving education in developing countries
  - School Access (Duflo 2001, Linden et al. 2010)
  - Conditional Cash Transfers (Fizsbein & Schady 2010, Baird et al 2011)
  - Information (Jensen 2010, Nguyen 2010)
  - Class size (Angrist & Lavy 1999; Urquiola 2006; Duflo et al 2010)
  - Contract teachers (Duflo et al 2010; Muralidharan & Sundararaman 2010)
  - Incentives
    - Diagnosis: Kremer et al (2005); WDR 2004
    - Teachers: Lavy 2002, 2008; Glewwe et al 2004; Muralidharan & Sundararaman 2011; Duflo et al 2010
    - Students: Kremer et al 2009
  - Other inputs/pedagogy
    - Technology (Banerjee et al. 2007; He, Linden & Macleod 2008)
    - Tracking (Duflo et al. 2011)
  - Choice/competition
    - Angrist et al 2002 and 2006; Hsieh & Urquiola 2005

Lecture Plan

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Questions/Contributions

- Does teacher performance-pay improve test scores?
- What, if any, are the negative consequences?
- How do group and individual incentives compare?
- How does teacher behavior change?
- How cost effective is the incentive program?
- How will teachers respond to the idea?

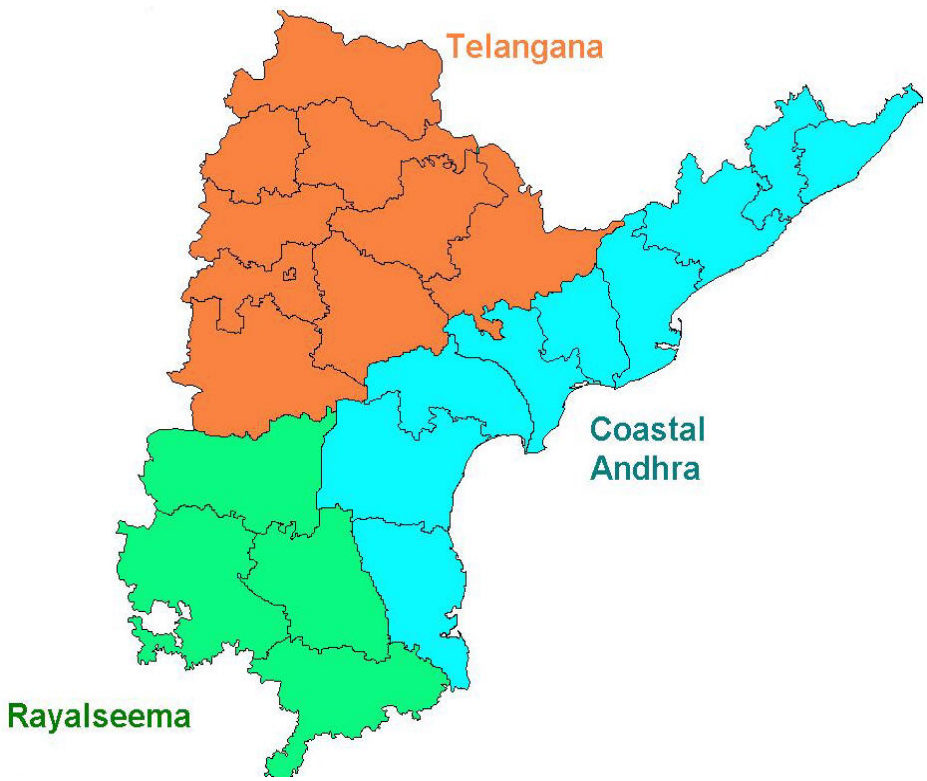
Potential concerns with such a program are addressed pro-actively in the study design

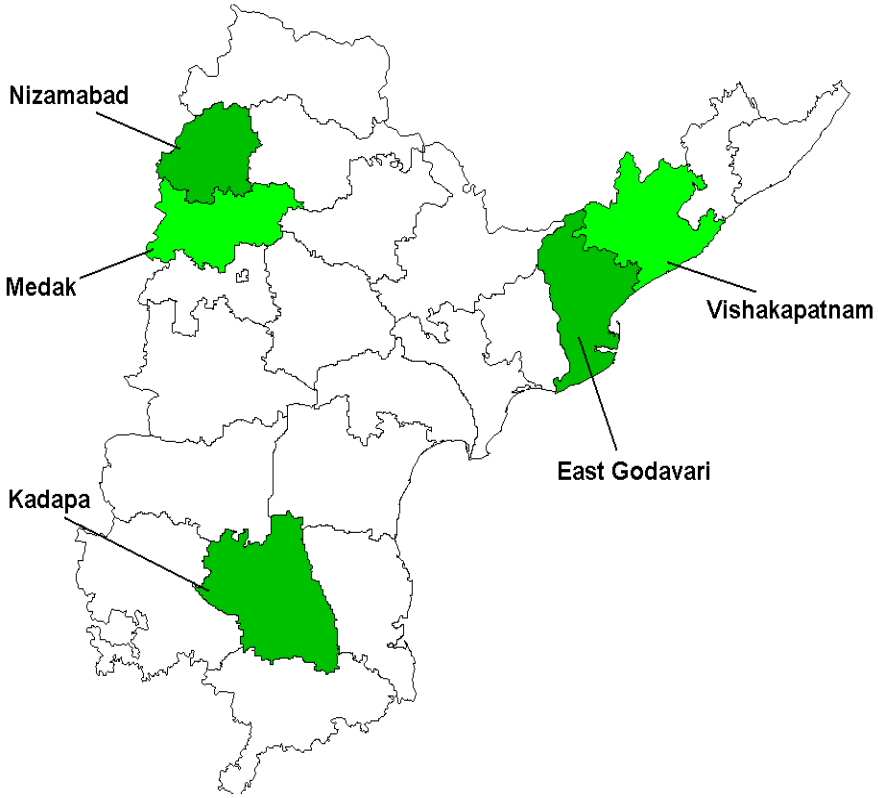
Potential concern	How addressed
Reduction of intrinsic motivation	• Recognize that framing matters • Program framed in terms of recognition and reward for outstanding teaching as opposed to accountability
Teaching to the test	• Less of a concern given extremely low levels of learning • Research shows that the process of taking a test can enhance learning • Test design is such that you cannot do well without deeper knowledge / understanding
Threshold effects/ Neglecting weak kids	• Minimized by making bonus a function of average improvement of all students, so teachers are not incentivized to focus only on students near some target; • Drop outs assigned low scores
Cheating / paper leaks	• Testing done by independent teams from Azim Premji Foundation, with no connection to the school

Design Overview

	INCENTIVES (Conditional on Improvement in Student Learning)			
INPUTS (Unconditional)		NONE	GROUP BONUS	INDIVIDUAL BONUS
	NONE	CONTROL (100 Schools)	100 Schools	100 Schools
	EXTRA CONTRACT TEACHER	100 Schools		
	EXTRA BLOCK GRANT	100 Schools		

Sampling


Telangana
Coastal Andhra
Rayalseema


Nizamabad
Medak
Vishakapatnam
East Godavari
Kadapa

Sample Balance (Baseline Characteristics)

Table 1: Sample Balance Across Treatments

	Panel A (Means of Baseline Variables)			
	[1]	[2]	[3]	**[4]**
	Control	Group Incentive	Individual Incentive	**P-value (Equality of all groups)**
School-level Variables				
Total Enrollment (Baseline: Grades 1-5)	113.2	111.3	112.6	**0.82**
Total Test-takers (Baseline: Grades 2-5)	64.9	62.0	66.5	**0.89**
Number of Teachers	3.07	3.12	3.14	**0.58**
Pupil-Teacher Ratio	39.5	40.6	37.5	**0.66**
Infrastructure Index (0-6)	3.19	3.14	3.26	**0.84**
Proximity to Facilities Index (8-24)	14.65	14.66	14.72	**0.98**
Baseline Test Performance				
Math (Raw %)	18.4	17.8	17.4	**0.72**
Math (Normalized - in Std. deviations)	0.022	-0.003	-0.019	**0.74**
Telugu (Raw %)	35.0	34.8	33.4	**0.54**
Telugu (Normalized - in Std. deviations)	0.019	0.014	-0.032	**0.52**

Sample Balance (Teacher Attrition/Turnover)

Teacher Turnover and Attrition

Year 1 on Year 0				
Attrition from beginning of the year (%)	0.30	0.34	0.31	**0.63**
New teachers joining during the year (%)	0.34	0.33	0.32	**0.90**
Year 2 on Year 1				
Attrition from beginning of the year (%)	0.04	0.06	0.06	**0.53**
New teachers joining during the year (%)	0.05	0.04	0.03	**0.37**
Year 2 on Year 0				
Attrition from beginning of the year (%)	0.32	0.37	0.34	**0.47**
New teachers joining during the year (%)	0.37	0.36	0.33	**0.62**

Sample Balance (Student Attrition/Turnover)

	Panel B (Means of Endline Variables)			
Student Turnover and Attrition				
Year 1				
Student Attrition (Students who did not take an endline test as a fraction of those who took a baseline test)	0.08	0.07	0.07	0.20
Baseline Maths test score of attritors (Equality of all groups)	-0.16	-0.15	-0.19	0.95
Baseline Telugu test score of attritors (Equality of all groups)	-0.26	-0.19	-0.25	0.81
Year 2 on Year 0				
Student Attrition (Students who did not take an endline test as a fraction of those who took a baseline test)	0.26	0.24	0.25	0.70
Baseline Maths test score of attritors (Equality of all groups)	-0.14	-0.07	-0.09	0.73
Baseline Telugu test score of attritors (Equality of all groups)	-0.19	-0.14	-0.20	0.78

Specification

$$T_{ijkm}(Y_n) = \alpha + \gamma \cdot T_{ijkm}(Y_0) + \delta \cdot Incentives + \beta \cdot Z_m + \varepsilon_k + \varepsilon_{jk} + \varepsilon_{ijk}$$

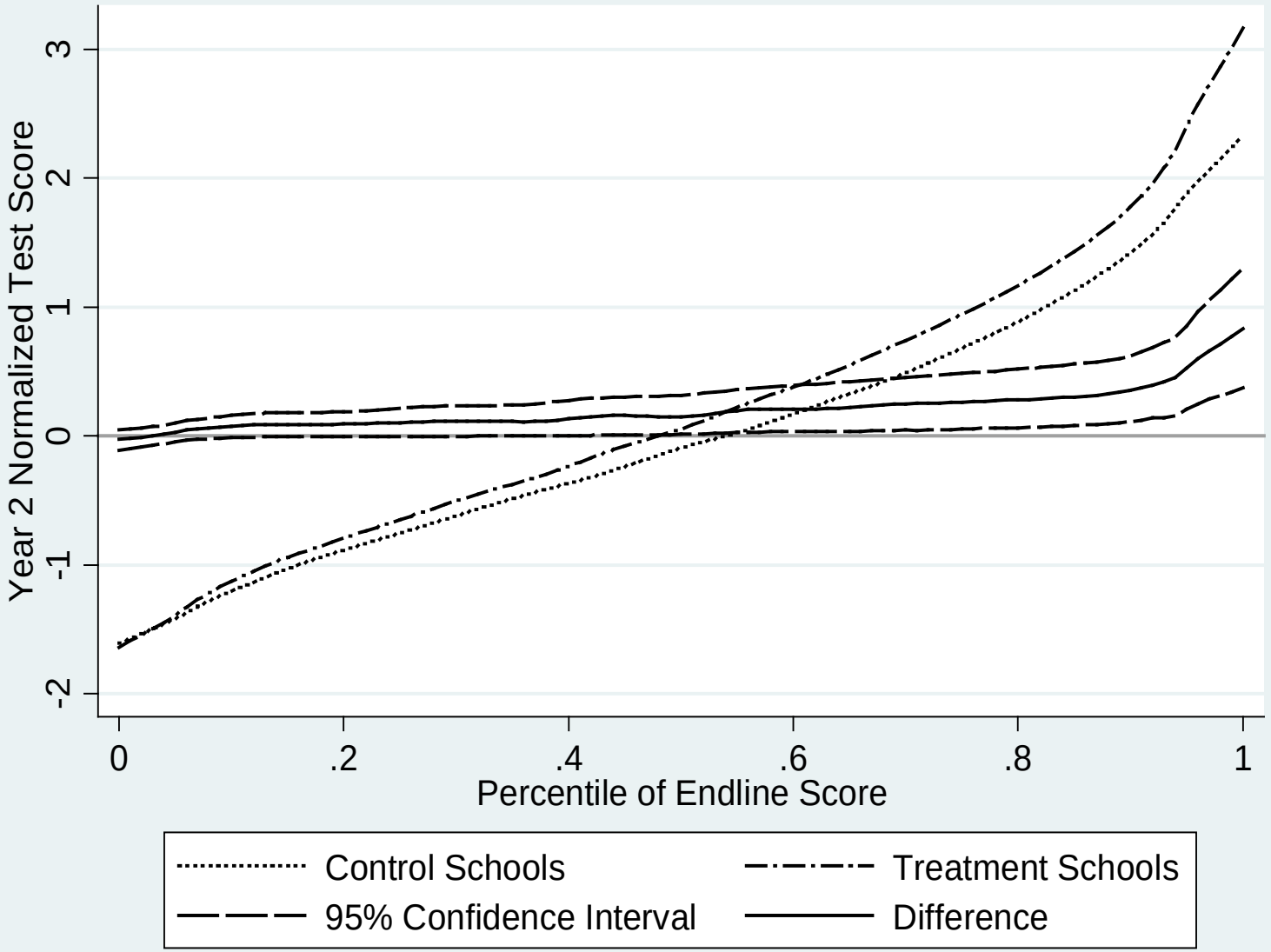
$$i = Child,\ j = Class, k = School, m = Mandal(Sub - District)$$

Impact of Incentives on Test Scores

Table 2: Impact of Incentives on Student Test Scores

	Dependent Variable = Normalized End of Year Test Score						
	Combined			**Maths**		**Telugu**	
	Year 1 on Year 0	**Year 2 on Year 1**	**Year 2 on Year 0**	**Year 1 on Year 0**	**Year 2 on Year 0**	**Year 1 on Year 0**	**Year 2 on Year 0**
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Normalized Lagged Test Score	0.5	0.553	0.45	0.49	0.418	0.516	0.484
	(0.013)***	(0.016)***	(0.015)***	(0.017)***	(0.022)***	(0.014)***	(0.014)***
Incentive School	**0.153**	**0.143**	**0.217**	**0.188**	**0.277**	**0.119**	**0.158**
	(0.042)***	(0.035)***	(0.047)***	(0.049)***	(0.055)***	(0.038)***	(0.043)***
Observations	68702	78613	49516	34121	24592	34581	24924
R-squared	0.29	0.29	0.23	0.28	0.22	0.32	0.25

Quantile Treatment Effects

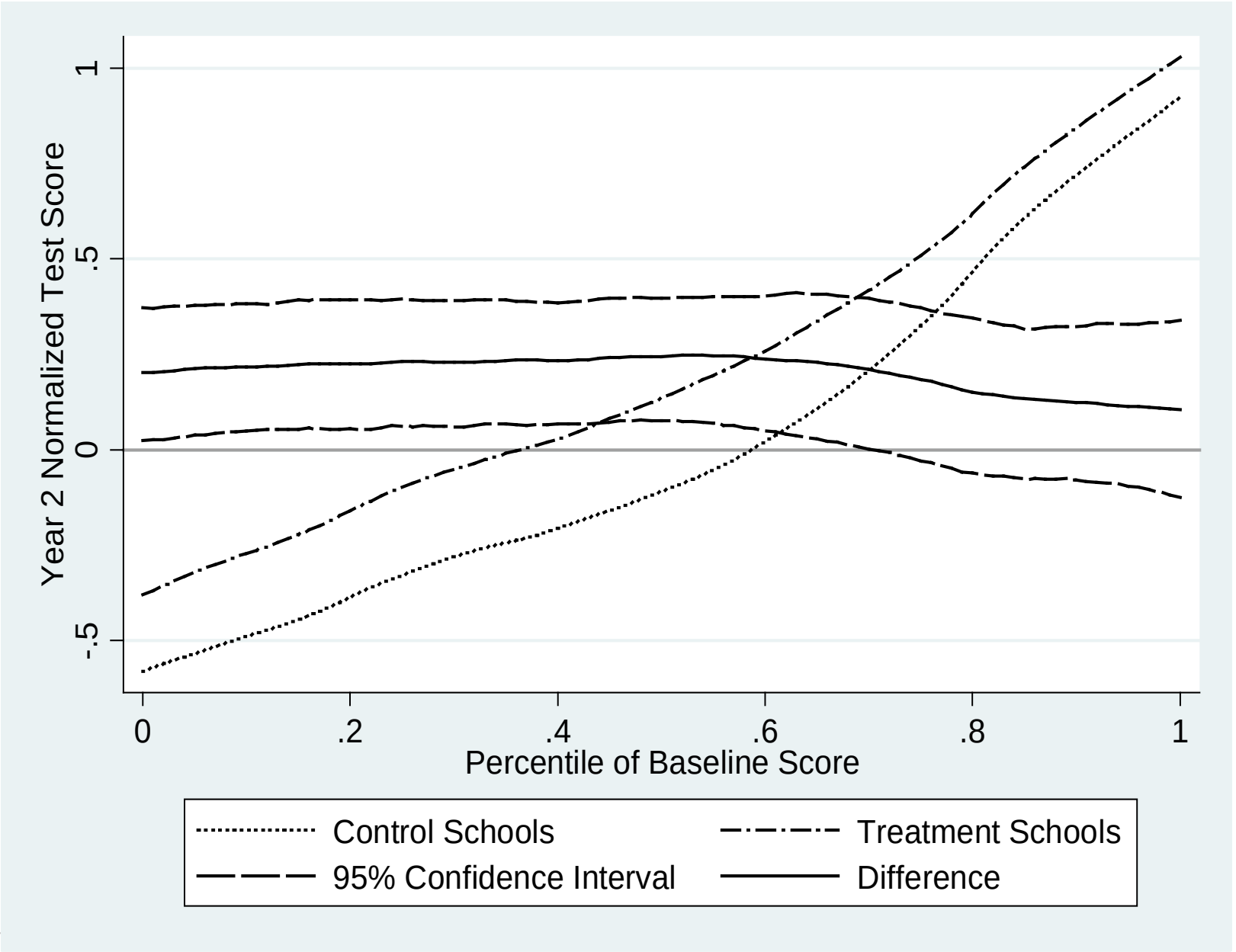


Heterogeneous Treatment Effects (1 of 2)

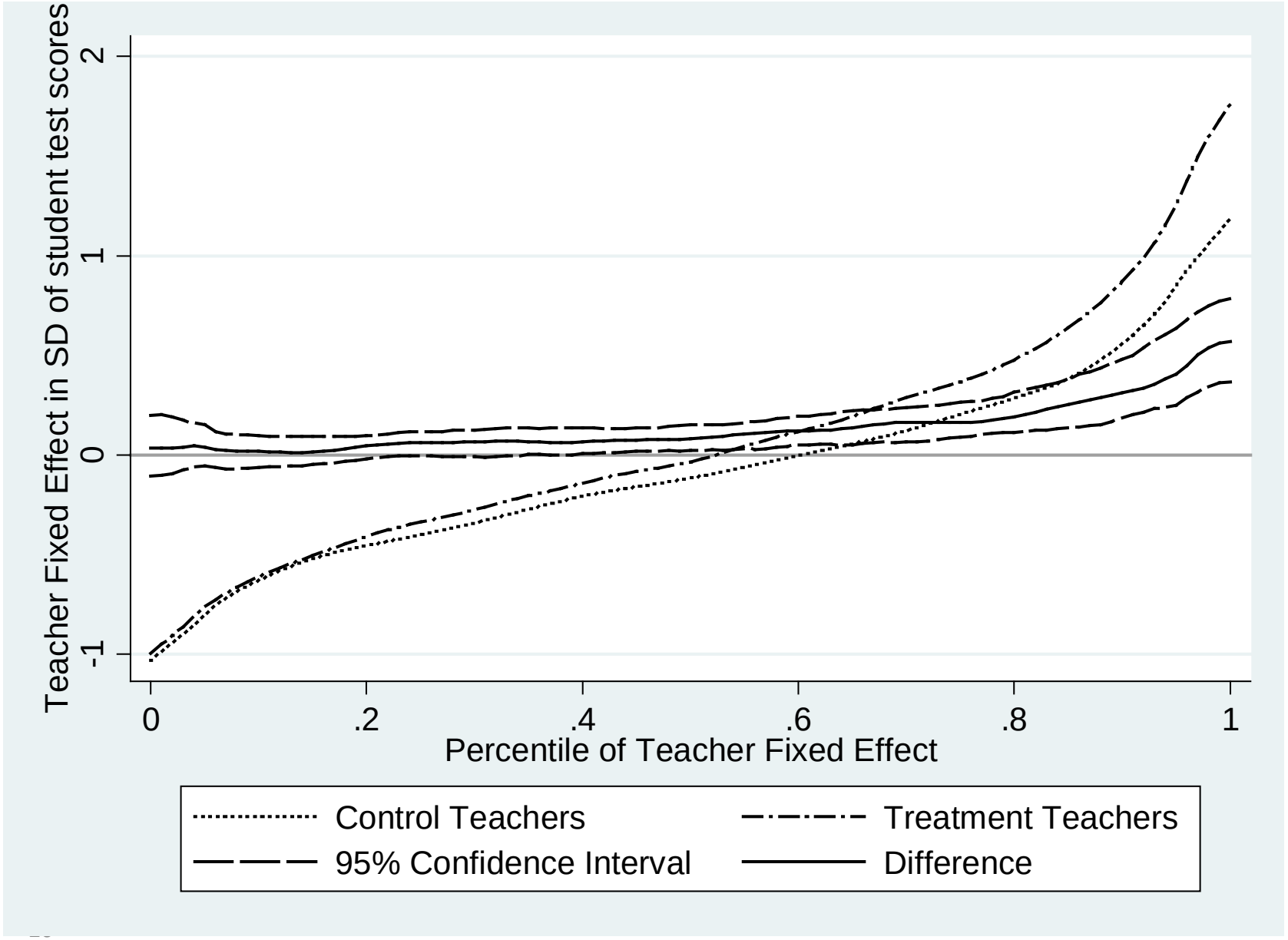
Panel A: Household and School Characteristics

	[1] Number of Students in School	[2] School Proximity (8 - 24)	[3] School Infrastructure (0 - 6)	[4] Household Affluence (0 - 7)	[5] Parental Literacy	[6] Scheduled Caste/ Tribe	[7] Male Student	[8] Normalised Baseline Score
	Year 2 on Year 0							
Incentive School	0.172	-0.131	0.200	0.087	0.206	0.221	0.234	0.217
	(0.057)***	(0.216)	(0.138)	(0.074)	(0.048)***	(0.048)***	(0.049)***	(0.047)***
Covariate	-0.048	-0.006	0.016	0.012	0.084	-0.054	0.019	0.453
	(0.031)	(0.010)	(0.041)	(0.015)	(0.019)***	(0.041)	(0.026)	(0.025)***
Interaction	**0.033**	**0.025**	**0.006**	**0.039**	**0.016**	**-0.006**	**-0.013**	**-0.005**
	(0.021)	**(0.015)***	**(0.042)**	**(0.019)****	**(0.025)**	**(0.054)**	**(0.033)**	**(0.031)**
Observations	52756	49498	49498	45169	45169	49498	45197	49498
R-squared	0.22	0.23	0.23	0.24	0.24	0.23	0.24	0.23
	Year 1 on Year 0							
Incentive School	0.133	-0.032	0.068	-0.008	0.126	0.166	0.154	0.150
	(0.048)***	(0.160)	(0.107)	(0.063)	(0.044)***	(0.044)***	(0.043)***	(0.042)***
Covariate	-0.072	-0.013	0.004	0.014	0.087	-0.004	0.008	0.502
	(0.027)***	(0.008)	(0.024)	(0.013)	(0.016)***	(0.035)	(0.020)	(0.021)***
Interaction	**0.003**	**0.014**	**0.030**	**0.045**	**0.024**	**-0.068**	**0.005**	**-0.005**
	(0.016)	**(0.011)**	**(0.030)**	**(0.018)****	**(0.021)**	**(0.047)**	**(0.025)**	**(0.026)**
Observations	70560	66656	66656	63629	63629	68251	63667	68251
R-squared	0.29	0.30	0.30	0.31	0.31	0.29	0.31	0.29

Heterogeneous Effects by Student Baseline Score



Heterogeneity in Teacher Responsiveness



Heterogeneous Treatment Effects (2 of 2)

Panel B: Teacher Characteristics

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
	Education	Training	Years of experience	Salary (log)	Male	Teacher Absence	Active Teaching	Active or Passive Teaching
	Stacked regression using both years of data							
Incentive	-0.097	-0.148	0.238	1.230	0.205	0.175	0.077	0.077
	(0.152)	(0.167)	(0.061)***	(0.554)**	(0.060)***	(0.044)***	(0.045)*	(0.06)
Covariate	0.012	-0.032	-0.002	0.001	0.061	-0.049	0.032	0.058
	(0.031)	(0.040)	(0.003)	(0.043)	(0.056)	(0.107)	(0.066)	(0.07)
Interaction	**0.080**	**0.110**	**-0.007**	**-0.119**	**-0.072**	**-0.057**	**0.202**	**0.118**
	(0.047)*	**(0.058)***	**(0.004)***	**(0.061)***	**(0.068)**	**(0.146)**	**(0.083)****	**(0.09)**
Observations	88026	88270	88631	89198	90932	107472	107051	124569
R-squared	0.281	0.28	0.28	0.28	0.28	0.28	0.284	0.27

Mechanical versus Conceptual - Examples

Question 1:

$$\begin{array}{r} 34 \\ \times\ 5 \\ \hline \end{array}$$

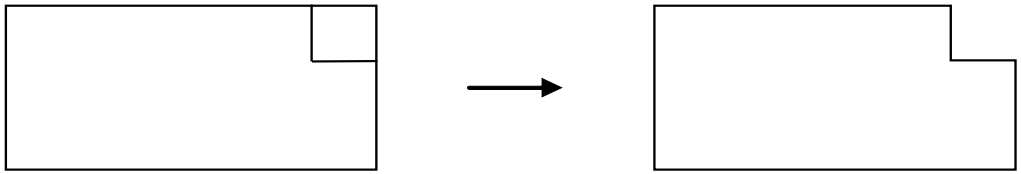
Question 2: Put the correct number in the empty box:

$8 + 8 + 8 + 8 + 8 + 8 = 8 \times \square$

Question 1: What is the area of the square below? _____

9cm

Question 2: A square of area 4 sq. cm is cut off from a rectangle of area 55 sq. cm.



What is the area of the remaining piece? _____ sq. cm

Impact of Incentives by Mechanical/Conceptual

Table 4: Impact of Incentives on Mechanical Versus Conceptual Learning

	Dependent Variable = Endline Test Score by Mechanical/Conceptual (Normalized by Mechanical/Conceptual Distribution in Control Schools)			
	Year 1 on Year 0		**Year 2 on Year 0**	
	[1]	[2]	[3]	[4]
	Mechanical	**Conceptual**	**Mechanical**	**Conceptual**
Normalized Baseline Score	0.485	0.339	0.449	0.308
	(0.012)***	(0.011)***	(0.013)***	(0.013)***
Incentive School	**0.138**	**0.138**	**0.173**	**0.183**
	(0.038)* **	**(0.043)*** **	**(0.041)*** **	**(0.046)*** **
Observations	67720	67720	42554	42554
R-squared	0.28	0.17	0.24	0.15

Performance on Non-Incentive Subjects

Table 7: Impact of Incentives on Non-Incentive Subjects

	Normalized Endline Score			
	Year 1 on Year 0		**Year 2 on Year 0**	
	Science	**Social Studies**	**Science**	**Social Studies**
Normalized Baseline Math Score	0.214	0.222	0.155	0.166
	(0.019)***	(0.018)***	(0.023)***	(0.023)***
Normalized Baseline Language Score	0.206	0.287	0.214	0.182
	(0.019)***	(0.019)***	(0.024)***	(0.024)***
Incentive School	0.107	0.135	0.112	0.177
	(0.052)**	(0.047)***	(0.045)**	(0.049)***
Observations	12011	12011	9166	9166
R-squared	0.26	0.3	0.18	0.18

Notes:

Social Studies and Science tests were only administered to grades 3 to 5

All regressions include mandal (sub-district) fixed effects and standard errors clustered at the school level.

* significant at 10%; ** significant at 5%; *** significant at 1%

Performance on Non-Incentive Subjects

	Dependent Variable: Normalized Test Score			
	Year 1 on Year 0		**Year 2 on Year 0**	
	[1]	[2]	[3]	[4]
	Science	**Social Studies**	**Science**	**Social Studies**
Predicted Normalized Math Score	0.382	0.341	0.278	0.336
	(0.032)***	(0.026)***	(0.041)***	(0.044)***
Predicted Normalized Language Score	0.297	0.486	0.424	0.344
	(0.028)***	(0.026)***	(0.037)***	(0.036)***
Residual of Normalized Math Score	0.355	0.310	0.192	0.223
	(0.021)***	(0.016)***	(0.030)***	(0.039)***
Residual of Normalized Lanugage Score	0.339	0.442	0.449	0.42
	(0.017)***	(0.016)***	(0.021)***	(0.024)***
Incentive School	**-0.007**	**0.015**	**-0.049**	**0.015**
	(0.031)	**(0.028)**	**(0.032)**	**(0.034)**
Observations	11181	11181	8993	8993
R-squared	0.48	0.54	0.40	0.39

Group versus Individual Incentives

Table 8: Impact of Group Incentives versus Individual Incentives

	Dependent Variable = Normalized Endline Test Score				
	Y1 on Y0	**Y2 on Y1**	**Y2 on Y0**		
	Combined	Combined	Combined	Maths	Telugu
Normalized Lagged Score	0.5	0.554	0.451	0.418	0.485
	(0.013)***	(0.016)***	(0.015)***	(0.022)***	(0.014)***
Individual Incentive School (II)	0.16	0.198	0.271	0.321	0.223
	(0.049)***	(0.044)***	(0.058)***	(0.068)***	(0.053)***
Group Incentive School (GI)	0.146	0.087	0.162	0.232	0.092
	(0.050)***	(0.045)*	(0.058)***	(0.071)***	(0.052)*
Observations	68702	78613	49516	24592	24924
F-Stat p-value (Testing GI = II)	0.78	0.05	0.12	0.29	0.03
R-squared	0.29	0.3	0.23	0.23	0.25

How did Teacher Behavior Change?

Table 11: Teacher Behavior (Observation and Interviews)

Incentive versus Control Schools (All figures in %)

Teacher Behavior	**Incentive Schools**	**Control Schools**	**p-Value of Difference**	**Coefficient of behavior indicator on test score**
Teacher Absence (%)	0.24	0.24	**0.82**	**-0.110** **
Actively Teaching at Point of Observation (%)	0.44	0.42	**0.57**	**0.124** ***
Did you do any special preparation for the end of year tests? (% Yes)	0.63	0.25	**0.000*** **	**0.102** ***
What kind of preparation did you do? (UNPROMPTED) (% Mentioning)				
Extra Homework	0.42	0.15	**0.000*** **	**0.085** **
Extra Classwork	0.46	0.17	**0.000*** **	**0.091** ***
Extra Classes/Teaching Beyond School Hours	0.16	0.04	**0.000*** **	**0.181** ***
Gave Practice Tests	0.31	0.10	**0.000*** **	**0.111** ***
Paid Special Attention to Weaker Children	0.21	0.05	**0.000*** **	**0.017**

Comparison of Inputs and Incentives

Table 9: Impact of Inputs versus Incentives on Learning Outcomes

	Dependent Variable = Normalized Endline Test Score								
	Year 1 on Year 0			**Year 2 on Year 1**			**Year 2 on Year 0**		
	Combined	**Math**	**Language**	**Combined**	**Math**	**Language**	**Combined**	**Math**	**Language**
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Normalized Baseline Score	0.511	0.493	0.535	0.552	0.495	0.614	0.460	0.422	0.497
	(0.010)***	(0.012)***	(0.011)***	(0.012)***	(0.016)***	(0.010)***	(0.012)***	(0.016)***	(0.012)***
Incentives	**0.156**	0.189	0.124	0.144	0.198	0.091	**0.217**	0.277	0.158
	(0.041)* **	(0.049)***	(0.038)***	(0.036)***	(0.044)***	(0.033)***	**(0.048)*** **	(0.056)***	(0.045)***
Inputs	**0.096**	0.11	0.082	0.047	0.047	0.047	**0.084**	0.092	0.076
	(0.037)* **	(0.043)**	(0.036)**	(0.03)	(0.04)	(0.03)	**(0.043)***	(0.049)*	(0.042)*
Difference (Incentives - Inputs)	**0.06**	0.08	0.04	0.10	0.15	0.04	**0.13**	0.19	0.08
F-Stat p-value (Inputs = Incentives)	**0.091**	0.061	0.199	0.006	0.000	0.170	**0.002**	0.000	0.042
Observations	112214	55743	56471	119788	59797	59991	82574	41043	41531
R-squared	0.29	0.27	0.32	0.29	0.26	0.33	0.21	0.21	0.24

Notes:

1. These regressions pool data from all 500 schools in the study: 'Group' and 'Individual' incentive treatments are pooled together as "Incentives", and the 'extra contract teacher' and 'block grant' treatments are pooled together as "Inputs"

Lecture Plan

- Education in Development Economics (20)
- Teacher Performance Pay (30)
- **School Grants (15)**
- Tracking and Peer Effects (15)
- Other papers on reading list (10)

Motivation

- The relationship between school spending and learning outcomes is of fundamental importance to education policy and has seen hundreds of empirical studies around the world

- Empirical public finance literature has traditionally paid careful attention to household (HH) responses to public programs

- But the education production function literature has rarely accounted for HH re-optimization in response to school inputs

- This is a critical gap for 2 reasons:
  - HH responses to school spending will mediate the impact of education spending on learning outcomes
  - Parameters of education production functions are not identified if HH's respond to changes in school-provided inputs

Contributions of this Paper

- Derive a theoretical dynamic model of HH optimization subject to budget and production function constraints
- Empirically test the two main predictions of the model in two completely different developing country settings with:
  - *Matched* data across schools and households *on spending*
  - *Panel* data on *test scores*
  - Sources of funding that are both *unanticipated* and *anticipated*
- India (Andhra Pradesh) – with a large-scale experiment that provided school block grants to randomly selected schools for two years (unexpected in first and expected in second)
- Zambia – with cross-sectional variation in both anticipated and unanticipated school grants in a scaled up national program
- Substantive and methodological contribution
  - School grants are an important education policy tool in several developing countries
  - Cannot ignore HH responses to policy changes in education

Preview of Results

- Model predicts that HH will respond differently to expected and unexpected increases in school spending
  - The direction of HH response to expected spending depends on whether these are substitutes or complements to HH inputs
- We find the same results in *both* settings
- HH and school spending are substitutes in both contexts
- HH spending falls in response to anticipated school grants, but not in response to unanticipated ones
- Student test scores improve significantly when the increase in school inputs is unanticipated, but *there is no significant effect on test scores* when the grant is anticipated
- Suggests thigh rate of pass through of non-teacher and non-infrastructure school spending in developing countries (whose long-run impact may not be higher than the income elasticity of test scores)

Theory – Basic Idea (Todd & Wolpin 2003)

- Take a standard education production function of the form:

$$TS_t = F(TS_{t-1}, w_t, z_t, \mu, \eta)$$

- The 'production function parameter' here is given by:

$$\frac{\partial TS_t}{\partial w_t} = \frac{\partial F(TS_{t-1}, w_t, z_t, \mu, \eta)}{\partial w_t}$$

- While, the 'policy parameter' is given by:

$$\frac{dTS_t}{dw_t} = \frac{\partial F(TS_{t-1}, w_t, z_t, \mu, \eta)}{\partial w_t} + \frac{\partial F(.)}{\partial z_t} \times \frac{\partial z_t}{\partial w_t}$$

The School Block Grant Experiment

- Block grant program details
  - Administered by the Azim Premji Foundation (APF) – completely independent of the government and therefore no "substitution bias" with other govt. spending
  - Grant amount was Rs. 125 ($3)/child
  - Guidelines that money had to be spent on inputs directly used by children
  - Baseline tests in June-July 05 (school year from mid June to mid April)
  - Program randomly assigned to 100 schools out of a representative sample of 200 schools in rural AP

- After random assignment, project staff from APF personally went to program schools and communicated the details of the program:
  - Schools were given 2-3 weeks to make a list of items to procure
  - Head teachers and APF staff jointly bought items and delivered them to the school (receipt of materials audited separately as well)
  - Schools never saw any cash but had freedom to choose materials to procure

Data

- Data on HH spending on education (of the child in the school studied) collected at 3 points in time: Y0 (pre-program), Y1 (after first year), Y2 (after second year)
  - Collected retrospectively to ensure inclusion of all spending over the course of the school year

- Data on learning outcomes collected by independent tests that were also conducted at 3 points in time: Y0 (June – July, 05); Y1 (March – April, 06), and Y2 (March – April, 07)

Spending of Block Grant

Table 2: Spending of School Grant (Average per Block Grant School)

	Year 1		Year 2	
	Rs.	%	Rs.	%
Textbooks	110	1.1	246	2.6
Practice books	1,782	17.7	1,703	17.8
Classroom materials	2,501	24.9	2,354	24.6
Child Stationary	4,076	40.5	4,617	48.2
Child Durable Materials	864	8.6	88	0.9
Sports Goods and Others	723	7.2	577	6.0
Average Total Expenditure per Block Grant School	10,057	100	9,586	100

Notes: The table shows the average spending in Rupees and spending share in each year of the school grant.

Household Spending Response (Logs)

Table 3 : Household Expenditure on Education of Children in Block Grant Schools (relative to comparison schools) over time

	Dependent variable is log of household expenditure on children's education
Block Grant School* Year 0 [β_3]	-0.023
	(0.032)
Block Grant School* Year 1 [β_4]	-0.041
	(0.027)
Block Grant School * Year 2 [β_5]	-0.212
	(0.034)***
Observations	37004
R-squared	0.135
P-value ($H_0 : \beta_4 = \beta_5$)	0.00

Evaluated at mean of HH expenditure, this implies an elasticity of substitution of -0.76 (cannot reject equal to 1)

Impact of School Grants on Test Scores

Table 4 : Impact of Block Grant on Student Test Scores (Separated by Year)

	Dependent Variable: Gain in Normalized Test Scores					
	Combined (Math & Language)		Mathematics		Language (Telugu)	
	[1]	[2]	[3]	[4]	[5]	[6]
	One-year Gain	Two-year Gain	One-year Gain	Two-year Gain	One-year Gain	Two-year Gain
Block Grant School	0.085	0.053	0.091	0.039	0.079	0.065
	[0.038]**	[0.045]	[0.042]**	[0.049]	[0.038]**	[0.046]
Observations	27704	19872	13778	9891	13926	9981
R-squared	0.269	0.325	0.293	0.325	0.254	0.238

Notes: All regressions include mandal (sub-district) fixed effects and standard errors clustered at the school level. Estimates of two-year gains do not include the cohort in grade 1 in the second year (since they only have exposure to one year of the program).

* significant at 10%; ** significant at 5%; *** significant at 1%.

Non-Parametric Treatment Effect Plots

Fig 1 (Y1 on Y0)

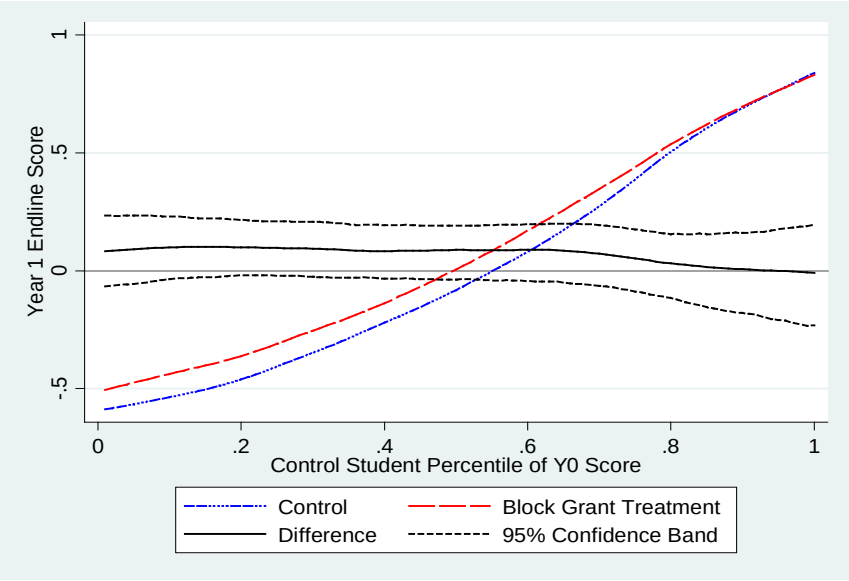
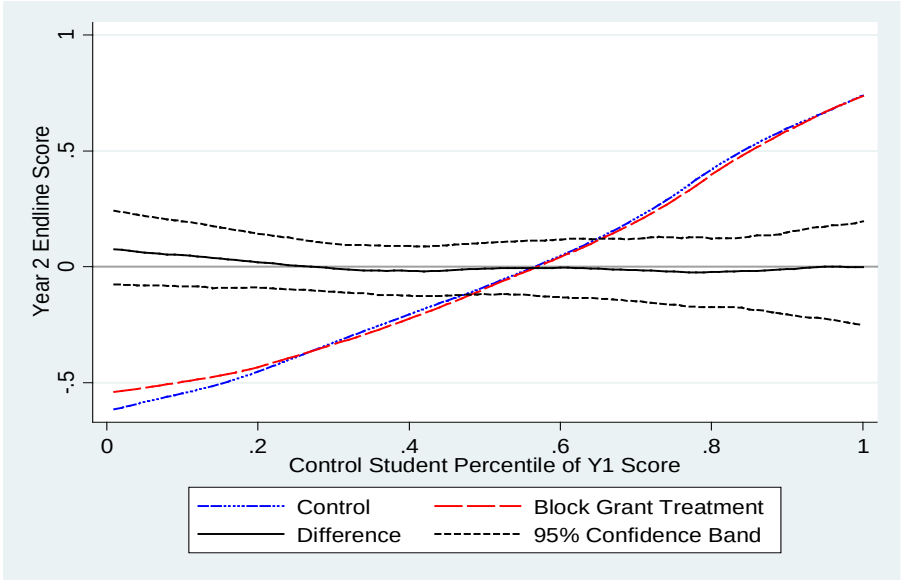


Fig 2 (Y2 on Y1)



Lecture Plan

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Motivation

- Debate over tracking in education:
  - Heterogeneity could make it harder to teach
  - But if students benefit from having stronger peers, tracking could hurt the weakest students
  - Relevant for many debates: decentralization, school choice

- Paper examines issue in developing country context
  - Most children are in poor countries; most evidence from U.S., other rich countries
  - Large, heterogeneous classes in lower primary school

Extra Teacher Project in Kenya

- 140 schools received funding to hire an extra teacher for grade 1 and create a new section
  - In Grade 1, class size fell from 80 to 40
- Random variation across schools
  - Tracking by prior achievement in half of these schools (tracking schools)
- Random variation within school
  - Random allocation of students to classes in non-tracking schools

Tracking and peer effects

- Effect of tracking
  - Students in tracking vs. non tracking schools
- Peer effects
  - RD design for students around the 50th percentile of initial distribution in tracking schools
  - Random variation in peer characteristics in schools with random assignment
- Companion paper looks at the other issues (class size, teacher incentives, etc.)

Highlights of results

- Tracking benefited *all* students
  - 0.14 SD increase in endline test scores
  - Effect persisted beyond the years program was in place

- Peer effects:
  - In tracking schools: being assigned to top or bottom section doesn't affect test scores for students near the 50th percentile at baseline
  - Within non-tracking schools: being assigned to higher achieving peers on average increases test scores

- Students affect peers directly *and* indirectly, through their impact on teacher behavior
  - Teacher effort
    - Teachers more likely to be in class and teaching in tracking schools, if assigned to top section
  - Focused teaching:
    - Students below median gain more from tracking in most basic competencies
    - Students above median gain more from tracking in more advanced competencies.

Overall effect of tracking

- Regression framework:

$$Test\ Score_{is} = \alpha_1 + \alpha_2\ tracking_s + \alpha_3\ bottom\ 50\%_i + \alpha_4\ bottom\ 50\% * tracking_{is} + X_{is}\gamma + v_{is}$$

If $\alpha_2 > 0$: tracking benefits students in top half
If $\alpha_2 + \alpha_4 > 0$: tracking benefits students in bottom half

- Test scores normalized:
  - Mean=0, std. dev=1 in non-tracking schools

- Standard errors clustered at school level

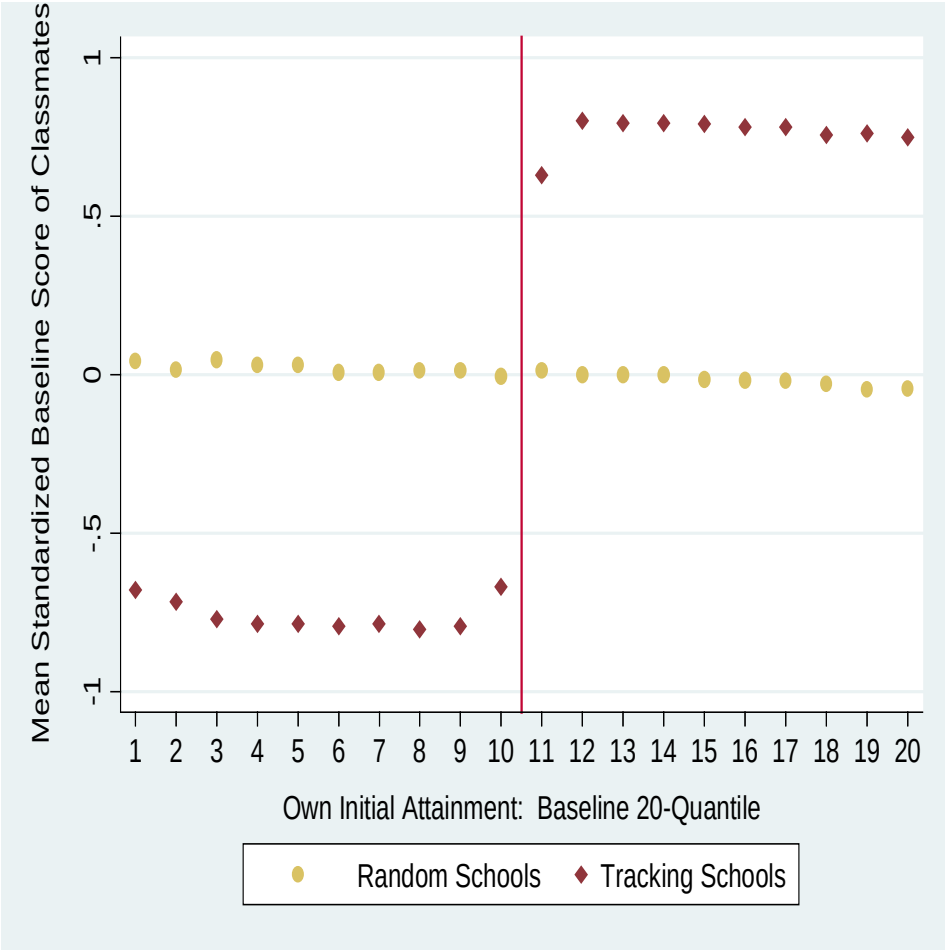
Tracking is good for everyone

SR results: after 18 months in program

	(1)	(2)	(3)	(4)
	Total Score			
(1) Tracking School	0.138	0.175	0.191	0.18
	(0.078)*	(0.077)**	(0.093)**	(0.092)*
(2) In Bottom Half of Initial Distribution			-0.036	
x Tracking School			(0.07)	
(3) In Bottom Quarter				-0.044
x Tracking School				(0.08)
(4) In Second to Bottom Quarter				-0.014
x Tracking School				(0.07)
(5) In Top Quarter				0.028
x Tracking School				(0.08)
Initial attainment percentile		0.018	0.02	0.022
		(0.001)***	(0.001)***	(0.002)***
Individual Controls	no	yes	yes	yes
Observations	5796	5282	5282	5282
Total effects on bottom half and bottom quarter				
Coeff (Row 1)+Coeff (Row 2)			0.155	
Coeff (Row 1)+Coeff (Row 3)				0.136
F Test: Total Effect = 0			4.39	2.864
p-value			0.04	0.093

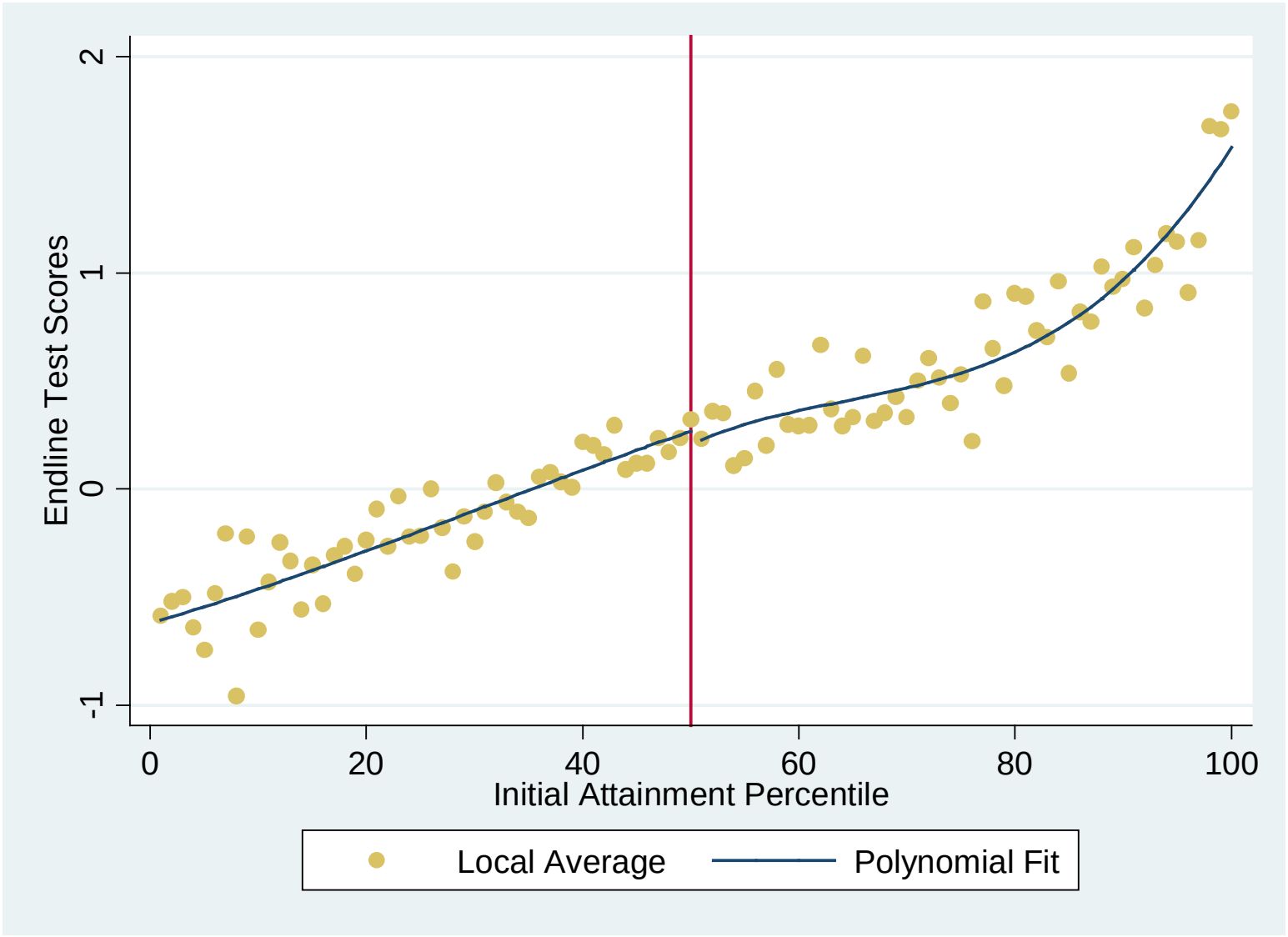
Peer effects in the middle

- Discontinuity in quality of peer group in tracked schools
- Results will show no corresponding discontinuity in tracked schools in test scores



End-line performance as a function of baseline performance in tracked schools

Quadratic fit estimated separately on either side of the threshold



The impact of section assignment: RDD estimates

	Total Score						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Specification 1: With third order polynomial in baseline attainment		Specification 2: With second order polynomial in baseline attainment estimated separately on either side		Specification 3: With local linear regressions (Fan)	Specification 4: Pair around the median	
Panel A: Reduced Form							
Estimated Effect of Bottom Section at 50th percentile	0.009	0.001	-0.045	-0.051	0.089	-0.057	-0.043
	(0.093)	(0.079)	(0.106)	(0.089)	(0.329)	(0.141)	(0.157)
Observations (Students)	2959	2959	2959	2959	2959	149	149
School Fixed Effects		yes		yes			yes

IV: Average peer quality instrumented by being in bottom half at baseline

Panel C: First Stage for IV	*Dep. Var: Average Total Score of Peers*	
In Bottom Half of Initial Distribution	-0.731	-0.743
	(0.047)***	(0.021)***
Observations (Students)	2959	2959
R-squared	0.42	0.78
School Fixed Effects	no	yes

IV: Average peer quality instrumented by being in bottom half at baseline

	Total Score			
	(1)	(2)	(6)	(7)
	Specification 1: With third order polynomial in baseline attainment		Specification 4: Pair around the median	
Panel B: IV (Second Stage)				
Mean Total score of Peers	-0.013	-0.001	-0.073	-0.005
	(0.127)	(0.102)	(0.221)	(0.236)
Observations (Students)	2959	2959	149	149
School Fixed Effects	no	yes	no	yes

Education Reading List

ANGRIST, J., E. BETTINGER, E. BLOOM, E. KING, and M. KREMER (2002): "Vouchers for Private Schooling in Colombia: Evidence from a Randomized Natural Experiment," *American Economic Review*, 92, 1535-1558.

BANERJEE, A., S. COLE, E. DUFLO, and L. LINDEN (2007): "Remedying Education: Evidence from Two Randomized Experiments in India," *Quarterly Journal of Economics*, 122, 1235-1264.

(*) DAS, J., S. DERCON, J. HABYARIMANA, P. KRISHNAN, K. MURALIDHARAN, and V. SUNDARARAMAN (2011): "School Inputs, Household Substitution, and Test Scores," National Bureau of Economic Research Working Paper 16830.

DUFLO, E. (2001): "Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment," *The American Economic Review*, 91, 795-813.

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KREMER, M., E. MIGUEL, and R. THORNTON (2009): "Incentives to Learn," *Review of Economics and Statistics*, 91, 437-456.

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