Upping the Ante: Equilibrium Effects of Unconditional School Grants

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Question

- Market failures underpin the efficiency rationale for state intervention, including in education
- Movement from state financing and provision to alternate models
  - State financing, private provision: Extensive use of vouchers (HSEIH AND URQUILOA 2006, MURALIDHARAN ET AL. 2015, BARRERA-OSORIO ET AL. 2017); Charter schools in the U.S.(HOXBY AND ROCKOFF 2004; HOXBY, MURARKA AND KANG 2009, ABDULKADIROGLU ET AL. 2016; ANGRIST ET AL. 2013), PPP arrangements (ROMERO ET AL. 2017)
  - One key finding: Market structure and intervention design matters (EPPLE ET AL. 2017, MURNANE ET AL. 2017, NIELSEN 2017)
  - Nevertheless, difficult to attribute supply side responses to policy changes in the literature (see, for instance, debate on Chile: FEIGENBERG, RIVKIN & YAN 2017)
- Growth of private schools in LMIC offers opportunity to experimentally link supply side responses to policy changes in local markets
  - Understand market failures in education
  - Understand how market structures mediate interventions
  - Teacher labor market and informational constraints (ANDRABI ET AL. 2013, ANDRABI ET AL. 2017; CARMAGO ET AL. 2017)

Overview

What we do

- Provide (unconditional) cash grants of Rs.50,000 ($500) to rural private schools in Pakistan (15% of median annual revenue).
- Very little monitoring, regulation, standards and no additional help in training or educational investments
- Village-level treatment with varied financial saturation: Vary grant coverage level from LOW SATURATION (only one private school in village) to HIGH SATURATION (all private schools in village), noting that there are 3.3 private schools in the average village
- Villages and schools experimentally assigned

What we find

- Schools in LOW SATURATION increase enrollment, but not test scores or price
  - Most invest in infrastructure
- Schools in HIGH SATURATION increase enrollment (less than in low saturation), test scores and price
  - Invest in infrastructure AND in teachers
- Results highlight how impact of financing is contingent upon design and market structure
- Use model to show how this differential impact is due to nature of market competition

Outline

- Context
- Theory
- Data
- Results
- Conclusion

Education markets in our context

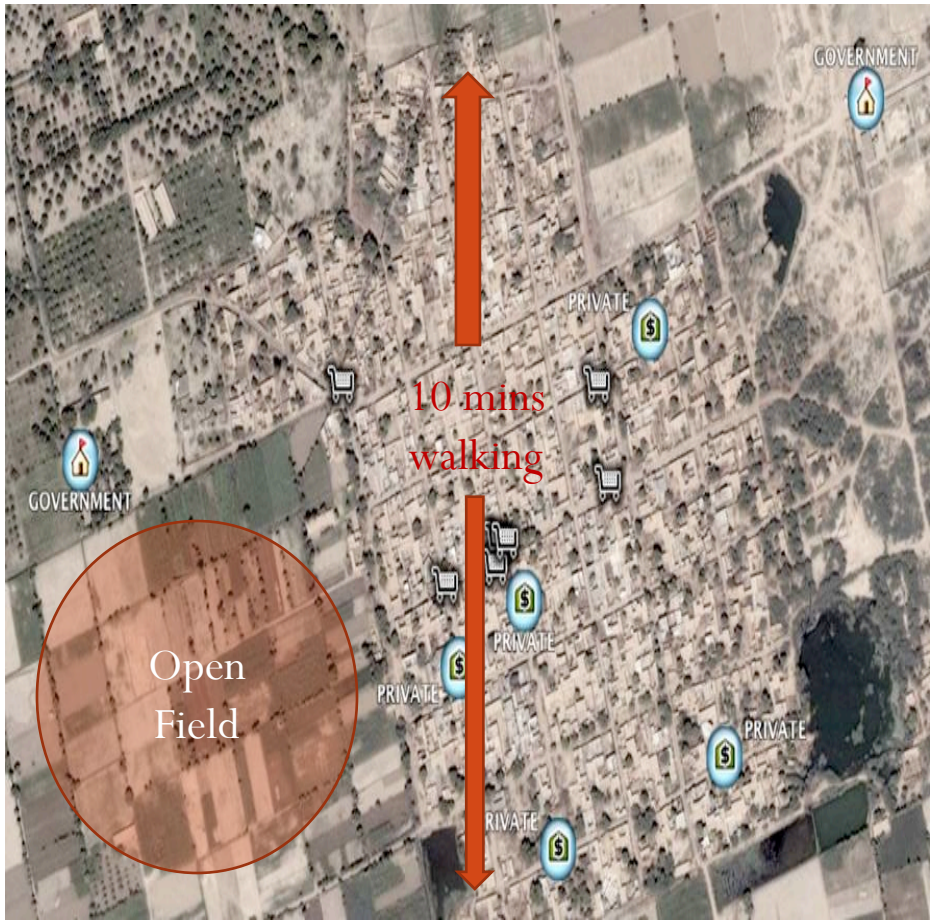
- Education market grew rapidly between 1990 and 2016
  - Number of private schools increased from 32,000 in 1990 to 47,000 in 2005 to 60,000 in 2016 in Punjab province
  - Fastest growth in rural areas
  - In 2010-11, 40% of primary enrollment in private schools

Villages are *closed* markets

>95% of primary age children attend schools in the village

>95% of attendance in village schools is from the village

Allows us to experimentally shock villages as independent markets



Market Functioning: 2003-2011

- Market works well in some respects: Considerable churn (57% of schools were there in both 2003 and 2011; 20% open in 2003 but shut later and 20% opened after 2003)
- Schools that shut down had 0.18sd lower test scores in 2003

BUT

- No increase in test scores of "always open" schools
- No increase in market shares of better performing schools
- Test scores in new schools the same as those that shut down
- Aggregate village test scores identical in 2003 and 2011 at a low level

Data from 26 control LEAPS villages (no interventions) between 2003 and 2011

School Owner Interviews

- In formative interviews, 95% of school owners say that funds for improvement come from `their own pocket' or school fees & 50% say that the biggest issue is that their schools need investment
- Asked what they would invest in, school owners favor infrastructure investments, and 75% believe that they can better increase revenue through new enrollment, rather than increasing quality

How does the provision of grants in this context change the market equilibrium

- Approach: Build quality into canonical model of capacity constraints (Kreps and Scheikman 1983) to generate predictions under low and high intensity and then test these predictions against our experiment

- Theory hinges on 3 main intuitions
- The first is the *nature of the trade-off between capacity and quality*
- The second is the *notion of the price war and how it plays out*
- The third is the idea of a *rationing rule* and what it implies

Theory Overview

- PLAYERS: Schools and households
- ACTIONS: Schools choose capacity, quality and price. Households choose whether to attend school, and if so, which school to attend
- PAYOFFS: Schools maximize profits; households maximize utility
  - Can incorporate certain type of social behavior among school owners, such as intrinsic utility from having children in school
- TIMING: Schools choose capacity and quality and then price
  - Note that price discrimination is competed out in oligopoly in simple settings; we don't see much in the data (Andrabi et al. 2016)
- TWIST: Schools face credit constraints
- **Trade-off**: Invest in capacity but risk price competition versus invest in quality at higher costs but decreased risk of price competition
- **Main Result**: As financial saturation increases, investing in capacity makes price war more likely and schools will be "more likely" to invest in quality

Theory: Numerical Example

- SCHOOLS
  - Low quality costs $0, High quality costs $4 fixed investment
  - Additional capacity (desks and chairs) cost $1 per child
- PARENTS: Homogeneous with <u>$3 WTP for low quality</u> and <u>$4 for high quality</u>
  - Market size fixed at 26 children
- BASELINE: Schools produce low quality with capacity of 10 children
- BASELINE EQUILIBRIUM: Both schools charge $3 and earn $3 profit per child for a total profit of $3*10=$30
  - They would like to cut the price and earn more money, but they don't have more capacity

Implies

- UNCOVERED MARKET: 6 children who would like to attend but there is no capacity

Experiment: High versus Low Saturation

- In Low Intensity, 1 School receives $5
- Profit is Revenue + $5 –Cost of Investment
- *Expand Capacity:* At $1 per child, can enroll 5 more children and earn $15 more, for total profit of $45
- *Increase Quality:* Purchase higher quality for $4, buy 1 additional chair and charge $4. With 11 children, profit = $44
- $\prod$(Capacity investment)> $\prod$(quality investment)

- In High Intensity, both schools receive $5
- *Expand capacity:* Both schools spend $5 on desks and chairs. Can enroll 10 more children, but only 6 children in the "uncovered market". This triggers price competition.

Theory: Price war

- **Lemma:** No pure strategy Nash Equilibria
- $3 not an equilibrium price: Can charge $3-e, and get 15 children, while other school gets only 11 (true for ANY price > $0)
- But $0 is not an equilibrium price either, since can charge 0+e, and get 11 children for positive profit > zero profit
- Therefore, only equilibrium is in mixed strategies
- Randomize between $3 and lower bound $2.2
  - At $3, other school randomizing between $3 and $2.2 and I am being undercut for sure. I will get residual demand of 11 and a profit of $33
  - In mixed strategy NE, I should be indifferent between any two prices. Let lower bound = x. Then, if school charges x, it undercuts the other school for sure and gets 15 children with profit = 15*x. So, 15*x=$33, or x = $2.2
- Schools indifferent between any two prices in this range
- Profit of each school is $33 compared to low intensity of $45

Theory: “Price War” mixed strategy

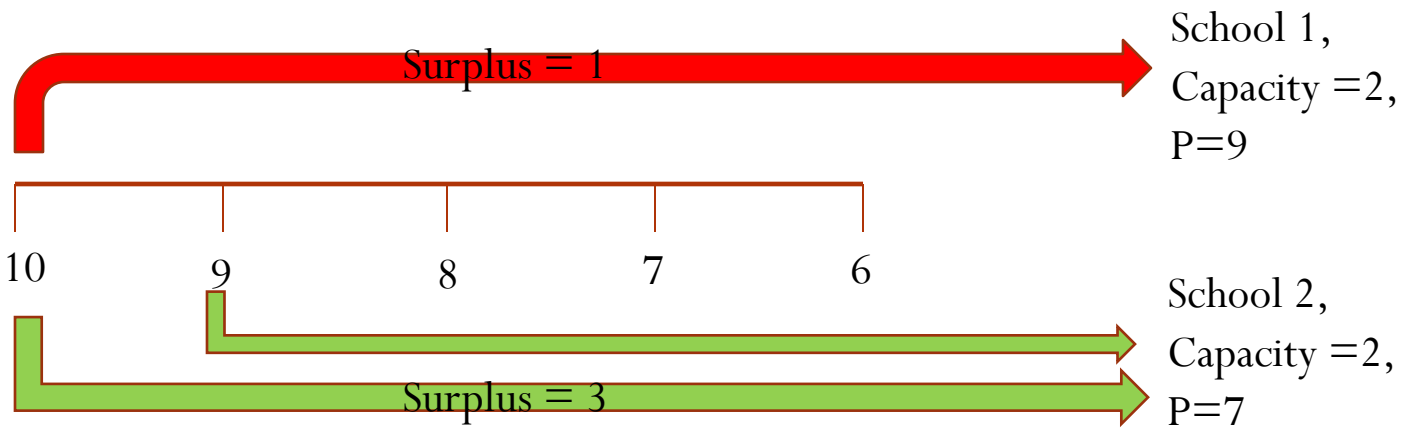
- <u>Equilibrium:</u> One school expands quality with associated profit of $44, other expands capacity by 5 children with profit of $45
- **Intuition**: Additional $ = {extra $ from existing students X # existing students} + {extra $ from new students at existing price}
  - As long as you can get many more new students at existing price, you should do this
  - But if you have to poach, price competition reduces profits: Better to `increase quality and charge more from existing students

Theory: High versus Low Saturation

- Constructed example highlights how investment strategies can differ depending on market saturation.
  - Other examples where schools invest in quality even in low-saturation, or capacity even in high-saturation.
- What *cannot* be done is to construct an example where school invests in quality in low saturation but <u>no school</u> invests in quality in high saturation.
  - This is the sense in which we use `more likely' in the theorem
- **Theorem:** Consider a cost of high quality, w. Then, if it is optimal for a school in Low Saturation to invest w, it is also optimal for a school in High Saturation to invest w. Further, there are always parameters such that it is optimal for schools in high saturation to invest in quality but **not** optimal for schools in low saturation to invest in w.

Theory: Consumer Heterogeneity

- If heterogeneity among consumers, WTP of the marginal consumer lower than that of average consumer
- **Rationing Rule**: Consumers choose in order of maximal surplus (Kreps-Scheinkman 1983)



Rationing rule implies existence of Nash Equilibrium

Theory: High versus Low Intensity

- **Lemma:** (Kreps-Scheinkman 1983) If quality is the same for both schools, in equilibrium, capacity and prices always given by Kreps-Scheinkman Cournot equilibrium
  - **Note:** If quantities exceed Cournot best responses, then price competition in mixed-strategies
- **Lemma**: If school invests in quality, then existence of pure-strategy NE
  - **Intuition**: Mixed-strategy NE follows because of discontinuities in profit function: When both firms have the same quality, if one price undercuts the other, they take all consumers up to their capacity. Quality re-introduces "smoothness" in the profit function and restores the pure strategy NE.
- **Theorem**: If treated school in low saturation invest in (high) quality, then there exists a perfect equilibrium of the high saturation arm in which at least one school invests on quality. The converse is not true.
  - Paper discusses (mild) assumptions required for this result.

Details

Predictions of Theory

- Greater enrollment increase per school in low saturation treatment
- Increase in quality and prices more likely in high saturation treatment
- Greater (private) profit in low saturation treatment

What about public schools?

- In the theory, we treat public schools as non-responsive outside options
- In a parallel paper, we evaluate what happens when we give such grant to public schools, which required generic administrative processes to be setup
  - Limited local decision making and flexibility
- Empirical approach was to evaluate what happens and see if public schools need to be included in endline surveys
  - Public schools lost 2-3% of enrollment, which we felt was too small to lead to responses
  - Very difficult (impossible?) to identify marginal movers, as there is considerable average churn in these villages
- Nevertheless, welfare will be different if there were public school responses as well

Sample

- Villages with at least 2 private schools in a single district in Punjab, Pakistan
- Identified through National Education Census (2005), verified through field visits
- Of 334 eligible villages (42% of all villages in district), randomly chose 266 villages based on power calculations with 855 schools
- Mean village has 2.45 public schools, 3.3 private schools and 524 children enrolled in private schools
- Mean private school enrollment is 164, with fees of Rs.238.4 ($2.8) per month and monthly revenues of Rs.40,400 ($400)
- Considerable heterogeneity due to random sample from population
  - Fees range from Rs.81 (5th %tile) to Rs.502 (95th %tile)
  - Enrollment ranges from 45 (5th %tile) to 353 (95th %tile)

Sample

Notation

- **Control:** Villages with no grants (249 schools in 77 villages)
- **Low-Saturation Village**: We gave the grant to only one private school, randomly selected from among all private schools in the village (114 villages)
- **High-Saturation Village**: We gave the grant to all the private schools in the village (228 schools in 75 villages)
- **Low-treated**: The treated school in the low-saturation villages (114 schools in 114 villages)
- **Low-untreated**: The schools that were *not* treated in the low-saturation villages (264 schools in 114 villages)

Experiment Protocols

GRANT SIZE: Direct cash grants of Rs.50,000 ($500), which is 15% of median annual revenue of schools in sample

- 25-100 additional desks and chairs depending on quality
- 2 additional teachers at median private school wage
  - Teacher with 1sd higher TVA costs 40% percent, or Rs.10,000 more (Bau and Das 2017), which would imply a 0.15sd increase in test scores
- Not high enough to drive out other schools by subsidizing tuition: At an average fee of Rs.240, can fully subsidize 18 additional children, relative to total private enrollment in mean village of 523

GRANT DISBURSEMENT

Visit 1: Contract signed

Visit 2: First tranche disbursed (2 schools did not complete investment plan)

Visit 3: Monitoring visit and 2nd tranche disbursed (all schools receive the money)

Empirical Methodology

$$Y_{ijt} = \alpha_s + \delta_t + High_{ij} + LowTreated_{ij} + LowUntreated_{ij} + Y_{ij0} + \varepsilon_{ijt}$$

- Y_{ijt} is the outcome measure for school *i* in village *j* at time *t*
- Time *t* are follow-up (post-treatment) measurements, δ_t are round fixed effects
- α_s are strata fixed effects. Strata were constructed by village size and village average revenues.

Housekeeping

- Take-up, balance and attrition
- Standard errors clustered at village level.
- All regressions are weighted to account for differential treatment probability in low-saturation villages.

Results: “First Stage” Grant usage

- In **High** intensity villages, each school increased expenditures by Rs.35,000 (70% of grant amount)
- In **Low-treated** schools increased expenditure by Rs.30,800 (62% of grant amount)
- First evidence of credit constraints: Following logic in Banerjee-Duflo, if schools are not credit constrained, they should use the money to pay back existing loans with higher interest—we should see substitution with existing expenditures

Results (1): "First Stage" Grant usage

- No evidence of substitution, either in school or household accounts of school-owner

	Spending	School funding sources (Y/N)		HH borrowing (Y/N)			HH Loan Value
	(1) Fixed	(2) Self-financed	(3) Credit	(4) Any	(5) Formal	(6) Informal	(7) Any
High	34950.439***	-0.001	0.002	-0.010	0.020	-0.033	1063.026
	(9915.07)	(0.01)	(0.01)	(0.05)	(0.02)	(0.05)	(15092.81)
Low Treated	30719.202**	0.003	-0.006	-0.039	0.010	-0.053	17384.174
	(11883.92)	(0.00)	(0.01)	(0.05)	(0.02)	(0.05)	(29982.80)
Low Untreated	5086.919	-0.006	-0.011	-0.005	0.035*	-0.055	13611.930
	(10107.93)	(0.01)	(0.01)	(0.04)	(0.02)	(0.04)	(21581.81)
Baseline	0.161***	-0.000	-0.017	0.080**	0.208***	0.003	0.064*
	(0.04)	(0.00)	(0.01)	(0.04)	(0.05)	(0.04)	(0.03)
R-Squared	0.11	0.02	0.02	0.04	0.14	0.02	0.03
Obs	794	795	795	784	784	784	784
Test pval (H=0)	0.00	0.84	0.88	0.83	0.23	0.47	0.94
Test pval (LT = 0)	0.01	0.45	0.68	0.45	0.64	0.27	0.56
Test pval (LT = H)	0.73	0.31	0.56	0.60	0.65	0.69	0.60
Midline Control Mean	63117.10	1.00	0.02	0.30	0.06	0.25	44782.73

Results summary: Main outcomes

Treatment Arm	Enrollment	School Closure	Posted Fees	Posted Monthly Revenues	Collected Monthly Revenues	Fees based on collection	Test Scores
Low-treated	+22**	-.09***	+0	+9327**	+6992**	-8 to -19	-0
High	+9	-0	+19**	+5005*	+4642*	+18 to +29	+0.17**
Low-untreated	-0	-0	-0	-0	+0	-0	+0
Baseline/Control (School Level)	164	12.5	238	38654	38654	224	-0.21

Tables

Notes to Results on main outcomes

- **Enrollment and fees**
  - Enrollment increases in all grades; combination of new entrants and reductions in dropouts
  - Fee increases in all grades for high saturation villages
- **Closures**
  - Schools that closed in treatment were smaller, but did not have lower fees or test-scores
  - Among open schools, low-treated enrollment increase is 11.57 (p-val 0.13) and revenue increase ranges from Rs 3,191- 5,600 (noisy) for open schools
  - Price decline ranges from -21 to -10 (noisy) for open schools among low-treated
- **Revenues**
  - Precision increases when top-coded or trimmed
- **Test Scores**
  - Child-level increase is 0.22sd. <u>Not</u> due to compositional changes and unlikely due to peer effects (1-2 additional children per grade)
  - Increased more in Grade 3 and 4 compared to Grade 5; we did not test K-2

Additional Results

- What about equilibrium shifts in supply and demand due to differential grant amounts: Does the difference between low and high reflect different amounts of total grant across villages
  - Use variation in village-size to generate comparable per-capita grant disbursements and include as additional variables
  - No impact on differential impacts across high and low saturations

What did schools do? (1)

	Spending	Number purchased		Facility present (Y/N)			Other
	(1) Amount (PKR)	(2) Desks	(3) Chairs	(4) Computers	(5) Library	(6) Sports	(7) # Rooms Upgraded
High	25460.31***	5.97***	3.76***	0.20***	0.11***	0.10**	0.70***
	(8787.82)	(1.63)	(1.40)	(0.05)	(0.04)	(0.04)	(0.26)
Low Treated	19251.19**	8.71***	6.13**	0.17***	-0.03	-0.03	0.47
	(8702.52)	(2.45)	(2.76)	(0.06)	(0.05)	(0.04)	(0.40)
Low Untreated	-1702.36	1.31	0.87	0.04	-0.03	0.02	0.16
	(8376.89)	(1.40)	(1.19)	(0.04)	(0.04)	(0.03)	(0.26)
Baseline	0.09***	0.10*	0.12*	0.26***	0.32***	0.23***	0.71***
	(0.03)	(0.05)	(0.07)	(0.04)	(0.04)	(0.05)	(0.06)
R-squared	0.06	0.09	0.08	0.20	0.20	0.11	0.57
Obs	798	810	811	822	822	822	822
Test pval (H=0)	0.004	0.000	0.008	0.000	0.006	0.020	0.008
Test pval (LT = 0)	0.03	0.00	0.03	0.01	0.58	0.49	0.24
Test pval (LT = H)	0.50	0.31	0.45	0.60	0.01	0.01	0.59
Baseline Mean Depvar	57258.48	14.59	10.92	0.39	0.35	0.19	6.36

What did schools do? (2)

	School Costs		Teacher Roster		Teacher Salaries		
	(1) Total	(2) Wage Bill	(3) Total	(4) Num New	(5) All	(6) New	(7) Existing
High	3145.086*	2748.554*	0.432	0.462**	519.522**	577.659**	492.012*
	(1893.260)	(1511.167)	(0.321)	(0.191)	(257.936)	(266.468)	(284.287)
Low Treated	-1132.720	-822.293	0.327	0.243	-175.633	-83.822	-223.104
	(1721.848)	(1525.859)	(0.329)	(0.238)	(273.111)	(406.896)	(246.449)
Low Untreated	-303.012	67.239	0.296	0.235	194.483	76.208	253.391
	(1374.718)	(1107.136)	(0.292)	(0.181)	(202.527)	(236.051)	(201.692)
Baseline	0.884***	0.846***	0.765***				
	(0.069)	(0.078)	(0.051)				
Missing Dummy			387.284***				
			(25.940)				
R-Squared	0.688	0.633	0.502	0.193	0.201	0.225	0.196
Obs	1470.000	1470.000	1579.000	1604.000	11725.000	3903.000	7818.000
No of Post Obs	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Test pval (H=0)	0.098	0.070	0.179	0.017	0.045	0.031	0.085
Test pval (LT = 0)	0.511	0.590	0.322	0.307	0.521	0.837	0.366
Test pval (LT = H)	0.048	0.056	0.766	0.399	0.039	0.140	0.037
Baseline Mean Depvar	25387.019	19491.156	6.736		2648.387		2644.762

Returns

- ROI: Two models
  - Model 1: Returns only for 2 years, but can sell assets after 2 years at 60%
  - Model 2: Returns for 5 years and full depreciation
- Low-saturation: 61% (2 year) and 83% (5 year)
- High-saturation: 12% (2 year) and 32% (5 year)

- Compare to market interest rate of 15-20%
- Therefore the program is profitable without government subsidies
  - (Following the experiment and further work, loans from banks to private schools are scaling up rapidly)
- But where public subsidies may be required is moving from the low to the high saturation model, which raises the question of benefit to consumers under the two arms

Two ways to approach policy

- The policy **is** the grant (McKenzie 2017)
  - Evaluate giving grant to 3 villages in low-saturation model versus 1 village in high-saturation model
- The policy is a **loan-loss guarantee**: If you lend in the high saturation model, I will cover any losses you face due to additional default
  - Using the increased closure rates in high compared to low-saturation, appropriately accounting for loan tenure, we calculate the value of the loan-loss guarantee at Rs.17,363 over 4 years
- In both cases, we can try and compare test-score increases or, more ambitiously, consumer surplus

LLG Computation

Welfare Benefits

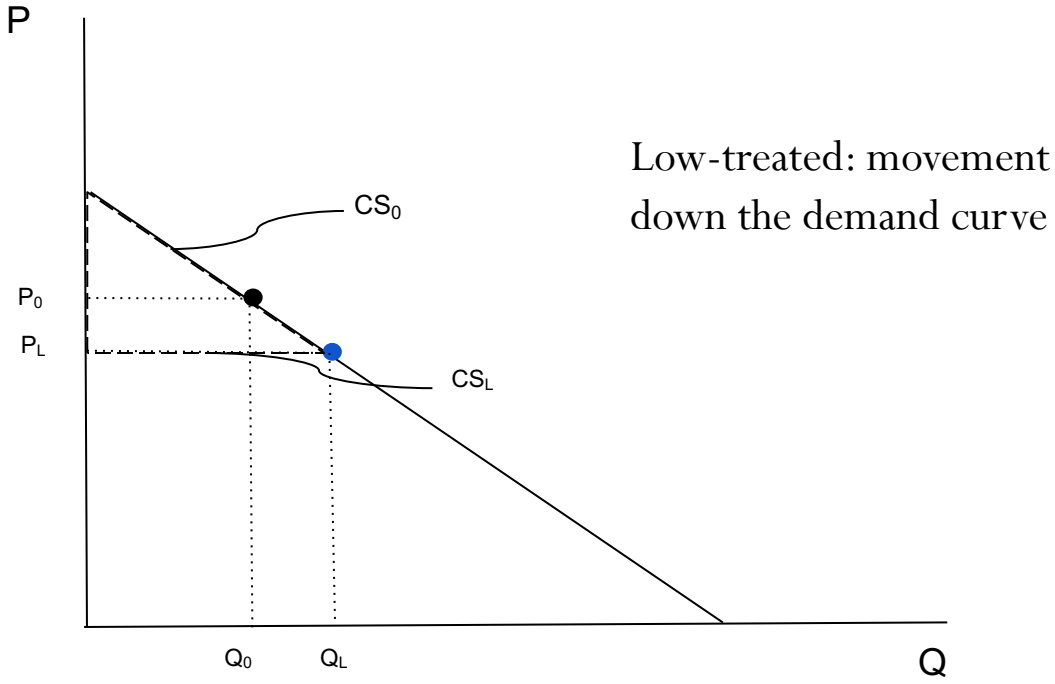
- Compare 150k in total spending with high and low-saturation designs
  - Compare grants to 3 schools in 1 village vs1 school each across 3 villages.
- Take all point estimates seriously

Beneficiary	High	Low-treated
School owners (PKR) – Monthly net revenues	5,295	10,918
Teachers (PKR) – Wage bills	8,662	-2514
Children– total sd gain in test scores from existing and new children	117.2	61.1
Parents– Consumer surplus (PKR)	?	?

Computations

Approach 2: Consumer Surplus

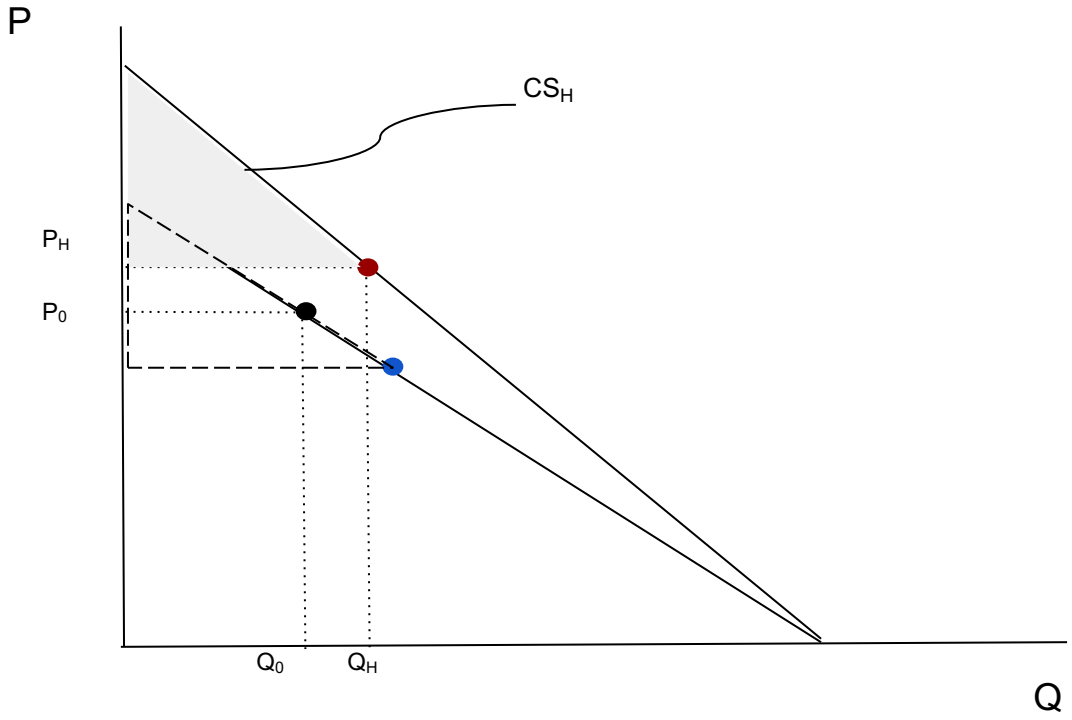
- Typically hard to do when price increases because quality also increases
- We can make progress under some assumptions: linear demand and upper bound to demand at zero price



Low-treated: movement down the demand curve

Approach 2: Consumer Surplus

- High-saturation: Curve pivots with higher quality and use p-q combination to calculate grey surplus triangle, and assess gains relative to baseline



Welfare Benefits

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Children– total sd gain in test scores from existing and new children	117.2	61.1
Parents– Consumer surplus (PKR)	7,560	4,080

CS Computations

Tie-back to theory

- Schools benefit from capital infusion
- Enrollment should increase more under low saturation model
- Quality and fees should increase more under high saturation model
- Expenditure patterns are consistent with these results
- Private returns higher in low compared to high saturation model
- Social returns arguably higher in high compared to low; could be much higher

Conclusions

- Capital infusions improve education market functioning
- Market behaves as theory predicts with financial saturation
- Broaden literature to (private) schools where it is possible that
  - Capital not that important
  - Hard for parents to evaluate and therefore pay for some quality improvements
  - Schools may not have technical know-how to produce higher quality service
- Substantial gains to by providing capital without training, regulation or oversight
- Deepen existing literature
  - Capital for selected firms may lead to spillovers (ROTEMBERG 2017)
  - But spillovers may not be predictive of what happens when capital is given to all firms when there are strategic considerations

Theory: Consumer Heterogeneity

- School 1 capacity = 2
- Second table shows NE prices when school 2 capacity increases from 1 to 6
  - Note: No 'uncovered' market (students who want to enroll but have no space at existing price) since can increase the price as demand downward sloping
- Up to capacity 6 for school 2, unique NE that prices at WTP of marginal consumer

At capacity 6, P*=3 no longer Nash

School 2 increases profits by charging 5 since 5x4=20>6x3=18

But 4 is not equilibrium either, as 4-e gets 6 students for profit 4x6=24

Then, for School 2 Capacity > 5, price competition in mixed strategies

But capacity 5 is precisely the Cournot best response to School 1 capacity = 2

Consumer	Valuation of low quality
A	10
B	9
C	8
D	7
E	6
F	5
G	4
H	3

School 2 CAP.	NE price	School 2 profits
1	8	8
2	7	14
3	6	18
4	5	20
5	4	20
6	Mixed	

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Theory: Consumer heterogeneity with quality

- Alternately, if one school chooses high quality and the other low quality, this product differentiation relaxes price competition
- Suppose School 2 again has a capacity of 6 while School 1 has a capacity of 2, but now School 2 chooses high quality with valuations as in table
  - Unique NE is School 1 charges 3 (consumers G and H) and School 2 charges 9(Consumers A through F). We prove that the mixed strategy case now disappears
- **Lemma**: Existence of pure-strategy NE if firms can invest in quality
  - **Intuition**: Mixed-strategy NE follows because of discontinuities in the profit function: When both firms have the same quality, if one price undercuts the other, they take all consumers up to their capacity. Quality re-introduces "smoothness" in the profit function and restores the pure strategy NE.

Consumer	Valuation of low quality	Valuation of high quality
A	10	20
B	9	18
C	8	16
D	7	14
E	6	12
F	5	10
G	4	8
H	3	6
I	2	4
J	1	2

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Summary Statistics

Table 1: Baseline Summary Statistics

Variable	(1) Mean	(2) 5th pctl	(3) 25th pctl	(4) Median	(5) 75th pctl	(6) 95th pctl	(7) Standard Deviation	(8) N
Panel A: Village level Variables								
Number of public schools	2.45	1.0	2.0	2.0	3.0	5.0	1.03	266
Number of private schools	3.33	2.0	2.0	3.0	4.0	7.0	1.65	266
Private enrollment	523.52	149.0	281.0	415.5	637.0	1,231.0	378.12	266
Panel B: School level Variables								
Enrollment	163.6	45.0	88.0	140.0	205.0	353.0	116.0	851
Monthly Fee (PKR)	238.4	81.3	150.0	201.3	275.0	502.5	166.1	851
Monthly revenue (PKR)	40,398.1	4,943.0	13,600.0	26,485.0	44,733.3	117,655.0	54,883.9	850
Monthly Operational Costs (PKR)	25,387.0	3,900.0	9,400.0	16,200.0	27,200.0	79,000.0	30,961.1	848
Annual fixed expenses (PKR)	78,860.9	0.0	9,700.0	33,000.0	84,000.0	326,000.0	136,928.2	837
School age (No of years)	8.3	0.0	3.0	7.0	12.0	19.0	6.7	852

Balance, Attrition and Take-up

- Balance: Both across villages and schools in distribution and ordinal tests
- Attrition: 5% in first year, 10% by end
  - Robustness of results to attrition shown in paper
- Take-up: 94% (96% for low and 93% for high intensity)
  - Reasons for not taking-up discussed in paper
- Survey included baseline, 3 “thick” rounds post treatment, 2 “thin” rounds post-treatment

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Experiment Protocols: Survey Timeline

Round	Dates	Months after treatment	Outcomes
Baseline	May-August 2012	-	Enrollment, Fees, Revenues, Costs, Child tests*, Teacher roster*
Treatment	Sep-Dec 2012	-	
1	May 2013	8	Enrollment, Fees, Revenues, Costs, Child tests, Teacher roster
2	Nov 2013	14	Enrollment, Fees, Revenues
3	Jan-Feb 2014	16	Enrollment, Fees, Revenues, Child tests
4	May 2014	20	Enrollment, Fees, Revenues
5	Nov 2014	26	Enrollment, Fees, Revenues, Costs, Child tests, Teacher roster

*Surveys that collect these outcomes were administered to only a random half of the sample at baseline.

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Results: Enrollment and fees

	Enrollment (All)			Closure	Enrollment (Open)	Posted Fees			Collected Fees
	(1) Year 1	(2) Year 2	(3) Overall	(4) Overall	(5) Overall	(6) Year 1	(7) Year 2	(8) Overall	(9) Per Child
High	8.86	9.12	9.01	-0.02	8.95*	17.68**	21.04**	18.83**	29.48
	(5.38)	(7.99)	(6.04)	(0.03)	(5.10)	(7.63)	(10.27)	(7.88)	(20.15)
Low Treated	18.83***	26.02***	21.80***	-0.09***	11.57	1.93	-2.51	0.51	-7.69
	(7.00)	(10.01)	(7.73)	(0.03)	(7.63)	(7.93)	(9.43)	(7.48)	(12.42)
Low Untreated	-0.31	1.00	0.31	-0.03	-2.43	0.07	-0.38	-0.00	3.37
	(5.09)	(7.23)	(5.51)	(0.03)	(5.41)	(6.24)	(9.13)	(6.49)	(10.45)
Baseline	0.78***	0.72***	0.75***		0.73***	0.83***	0.82***	0.83***	0.63***
	(0.04)	(0.06)	(0.05)		(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
R-Squared	0.69	0.53	0.62	0.05	0.63	0.71	0.73	0.72	0.14
Obs	2454	1605	4059	855	3599	1563	749	2312	2949
No of Post Obs	3	2	5	1	5	2	1	3	4
Test pval (H=0)	0.10	0.25	0.14	0.60	0.08	0.02	0.04	0.02	0.14
Test pval (LIT=0)	0.01	0.01	0.01	0.01	0.13	0.81	0.79	0.95	0.54
Test pval (LIT=H)	0.15	0.10	0.10	0.04	0.72	0.06	0.01	0.02	0.08
Baseline Mean Depvar	163.64	163.64	163.64		171.51	238.13	238.13	238.13	238.13

Notes:
* p<0.1, ** p<0.05, *** p<0.01

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Results: Revenues

	Fixed costs	Posted revenues			Collected revenues		
	(1) Year 1	(2) Full	(3) Top Coded 1%	(4) Trim Top 1%	(5) Full	(6) Top Coded 1%	(7) Trim Top 1%
High	34,950.4***	5,484.4	5,004.5*	4,771.6**	4,397.4	4,638.8*	3,571.0*
	(9,915.1)	(3,532.4)	(2,602.0)	(2,203.3)	(3,591.3)	(2,414.9)	(1,934.5)
Low Treated	30,719.2**	10,665.6**	9,327.2**	8,254.0**	7,923.8*	6,991.9**	5,399.6*
	(11,883.9)	(4,882.8)	(3,976.0)	(3,711.7)	(4,623.2)	(3,252.6)	(2,896.0)
Low Untreated)	5,086.9	-549.8	-684.5	328.7	494.5	431.0	737.6
	(10,107.9)	(2,750.1)	(2,345.6)	(1,887.7)	(2,560.2)	(2,225.9)	(1,711.9)
Baseline	0.2***	1.0***	1.0***	0.9***	0.8***	0.9***	0.7***
	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
R-Squared	0.11	0.65	0.65	0.58	0.55	0.62	0.53
Obs	794	2459	2459	2423	3213	3213	3165
No of Post Obs	1	3	3	3	4	4	4
Test pval (H=0)	0.00	0.12	0.06	0.03	0.22	0.06	0.07
Test pval (LIT=0)	0.01	0.03	0.02	0.03	0.09	0.03	0.06
Test pval (LIT=H)	0.73	0.35	0.32	0.37	0.52	0.52	0.55
Baseline Mean Depvar	78860.87	40181.05	38654.06	36199.17	40181.05	38654.06	36199.17
Follow-up Control Mean		38833.65	37878.89	33839.41	30865.04	30208.80	27653.03

Notes:
* p<0.1, ** p<0.05, *** p<0.01

Results: Revenues (open schools only)

	Posted			Collected		
	(1) Full	(2) Top Coded 1%	(3) Trim Top 1%	(4) Full	(5) Top Coded 1%	(6) Trim Top 1%
High (H)	5,471.4	4,872.2*	4,543.6**	4,748.8	4,775.2**	3,593.5*
	(3,432.9)	(2,498.8)	(2,094.2)	(3,482.7)	(2,425.1)	(1,871.3)
Low Treated (LT)	8,589.9*	7,287.7*	6,271.1*	5,600.5	4,747.5	3,191.9
	(4,988.8)	(4,032.3)	(3,742.7)	(4,804.2)	(3,349.9)	(2,964.8)
Low Untreated (LU)	-1,239.5	-1,434.3	-405.0	-119.6	-298.1	6.9
	(2,843.0)	(2,378.4)	(1,847.0)	(2,753.9)	(2,364.5)	(1,765.4)
Baseline Posted Revenues	1.0***	1.0***	0.9***	0.8***	0.9***	0.7***
	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)
R-Squared	0.66	0.67	0.61	0.57	0.64	0.56
Obs	2312	2312	2276	2948	2948	2900
No of Post Obs	3	3	3	4	4	4
Test pval (H=0)	0.11	0.05	0.03	0.17	0.05	0.06
Test pval (LT = 0)	0.09	0.07	0.10	0.24	0.16	0.28
Test pval (LT = H)	0.57	0.57	0.65	0.87	0.99	0.89
Baseline Mean Depvar	42174.89	39014.63	36476.06	40595.56	39014.63	36476.06
Follow-up Control Mean	38833.65	42668.19	36862.68	34699.44	33961.67	31122.54

Notes:
* p<0.1, ** p<0.05, *** p<0.01

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Results: Test Scores

	School level				Child level
	(1) Math	(2) Eng	(3) Urdu	(4) Avg	(5) Avg
High	0.171*	0.194**	0.131	0.167**	0.224**
	(0.0883)	(0.0933)	(0.0831)	(0.0843)	(0.0932)
Low Treated	-0.0720	0.0977	-0.0614	-0.0156	0.101
	(0.110)	(0.105)	(0.106)	(0.101)	(0.104)
Low Untreated	0.0429	0.0668	0.0234	0.0432	0.0101
	(0.0764)	(0.0818)	(0.0718)	(0.0720)	(0.0821)
Baseline Score	0.275**	0.433***	0.250**	0.359***	0.630***
	(0.110)	(0.0761)	(0.121)	(0.116)	(0.0486)
Missing Score Dummy	0.858*	1.859***	0.904	1.401***	30.67***
	(0.503)	(0.350)	(0.548)	(0.531)	(2.414)
R-Squared	0.18	0.14	0.13	0.16	0.21
Obs	740	740	740	740	12613
Test pval (H=0)	0.05	0.04	0.12	0.05	0.02
Test pval (LT = 0)	0.51	0.35	0.56	0.88	0.33
Test pval (LT = H)	0.03	0.36	0.07	0.07	0.24
Baseline Mean Depvar	-0.20	-0.18	-0.24	-0.21	-0.19

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Public subsidy for high intensity

- Assume schools that closed down would have defaulted on the loan and those that stayed open would have fully paid back the loan.
- Default rate in low-treated is 0.01 and in high-treated is 0.08.
- For a given loan size of 50,000 and annual flat interest rate of 15%, we compute the following expected loss:

	Low	High
Loan size	50,000	50,000
Tenure	1.5 years	4 years
Total loan value	61,250	80,000
Expected loss	612.5	6,400
Expected loss * 3 loans	1,838	19,200
Difference	17,363	

- **If offered as loan-loss guarantees, bank indifferent between high and low-intensity approaches.**

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Welfare calculations

- School owners: (Monthly revenues – operating costs)*3
  - Low-treated = (4748-1109)*3=10,918
  - High = (4775-3010)*3 = 5295

- Teachers: (Monthly wage bill)*3
  - Low-treated = -858*3 = -2,514
  - High = 2742*3 = 8226

- Children: Total test score gains = Gains for existing + gains for new children, new taken as 0.33sd gain from Andrabi et al, 2017
  - High = (492*0.22) + (27*0.33) = 117.2sd
  - Low-treated = (492.0.1) + (36*0.33) = 61.1

*closed schools are missing in these calculations

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Welfare calculations – Parents

- Low-treated: Quality does not change so movement along the demand the curve
  - Use baseline and low-treated p-q to derive demand curve
  - Q = 521 – 1.5P
  - Additional surplus = difference in areas between low-treated and baseline triangles = 1,360 Rs.
  - Total additional CS for 3 schools = 4,080 Rs
- High: Quality changes and demand curve pivots under our assumptions
  - New demand curve is Q = 521-1.3P
  - Additional surplus relative to baseline is 2,520 Rs per school
  - Total additional CS for 3 schools = 7,560 Rs.

*closed schools are missing in these calculations