# **Leveraging the Private Sector to Improve Primary School Enrollment:** Evidence from a Randomized Controlled Trial in Pakistan

## Structural Estimation

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# Motivation

- We use an experiment in Sindh, Pakistan, that created new schools in places where there was none.
  - In practice, we are creating the “market” for education in these locations
  - The experiment randomized at the village level: some villages received a new private schools—with public subsidies—and others did not receive any school.
- In a previous conference we showed the results of that experiment
- In this presentation, we are showing the results of using the experiment to estimate an structural model with the following objectives:
  - An important component of the intervention: entrepreneurs are free to tailor the characteristics of their schools and hire teachers as they see fit
  - In conjunction with our randomized research design, the structural model allows us to peer inside the “black box” of private schooling to evaluate how private schools improve educational outcomes.
  - We can contrast the social optimal solution, vis-à-vis the private solution (given by the demand and supply interaction)
  - Which characteristics of the schools would a social planner choose? How do they fare against the private solution?

# Map of the presentation

- I will discuss briefly the design of the experiment and the results from the experiment
- The bulk of the presentation would be centered on the structural estimation
  1. Initially we present the private solution: the demand for (characteristics) of schools and the decision of the entrepreneur (based on the observable demand)
  2. The solution of the social planner and the correspondence between the observed allocation and the social planner solution

# Experiment and result from the RCT

# Intervention

- Goal is to increase enrollment and achievement by using government funded private schools
  - Promoting Low-Cost Private Schooling in Rural Sindh (PPRS) program in 10 districts with lowest enrollment rates
- Entrepreneurs propose villages in which to create schools:
  - No primary school within 1.5 km radius
  - Proven demand (signed commitment from parents of 75 children)
  - Two female teachers with 8$^{th}$ grade education or higher
  - Adequate facility to house the school
- Once approved, the school is opened:
  - Tuition free enrollment (CO-ED schools)
  - Serve all children between five and nine
    - Expand one additional grade each year
  - Entrepreneurs paid a per-child subsidy to open and operate private schools
    - "Gender-Uniform subsidy": 350 rupees (USD 4.7) for each child enrolled
    - "Gender-Differentiated subsidy": 100 rupees more for girls
- The Sindh Education Foundation (SEF) runs the program:
  - Entrepreneurs are vetted by the SEF
  - The SEF measure attendance in visits to the school

# Research Design

- In late 2008, the SEF began soliciting applications.
  - Newspapers, radio, etc.
  - Entrepreneurs submitted applications
    - Proposed a village in which to locate the school
    - Documented the stipulated characteristics of the school
- SEF vetted the applications: 237 met criteria for study for randomization
- Baseline in April 2009
- 38 “large cities” were removed from the analytical sample
- Final analytical sample: 199 villages
  - Gender neutral stipend: 82 villages
  - Gender differentiated stipend: 79 villages
  - Control group: 38 villages
- Schools started in summer of 2009
- First follow-up households (census) village survey: June 2010
- Second follow-up household village survey: April/May 2011

**Table 5: Enrollment**

| | Self-Reported Enrollment | | | | Verified Enrollment | Highest Grade |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: Officially Eligible Children** | | | | | | |
| First Follow-Up | 0.498*** | 0.499*** | 0.483*** | 0.487*** | | |
| | (0.055) | (0.055) | (0.058) | (0.055) | | |
| Second Follow-Up | 0.316*** | 0.315*** | 0.313*** | 0.316*** | 0.294*** | 0.383*** |
| | (0.066) | (0.066) | (0.064) | (0.065) | (0.041) | (0.120) |
| **Panel B: Older Children** | | | | | | |
| First Follow-Up | 0.109* | 0.113* | 0.109** | 0.111** | | |
| | (0.057) | (0.058) | (0.049) | (0.052) | | |
| Second Follow-Up | 0.137** | 0.140** | 0.137*** | 0.122** | | -0.005 |
| | (0.057) | (0.057) | (0.051) | (0.053) | | (0.319) |
| Child Controls | no | yes | yes | yes | yes | yes |
| HH Controls | no | no | yes | yes | yes | yes |
| District FEs | no | no | no | yes | yes | yes |

Note: This table gives the treatment effects on self-reported enrollment during the first and second follow-ups, verified enrollment during the second follow-up, and the highest grade attained at the time of the second follow-up. The controls are as indicated. All standard errors are clustered at the village level. Statistical significance at the one-, five-, and ten-percent levels is indicated by ***, **, and * respectively.

**Table 6: Test Scores**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Math Test | 0.528*** | 0.519*** | 0.518*** | 0.626*** | 1.953*** |
| | (0.154) | (0.156) | (0.154) | (0.123) | (0.284) |
| Language Test | 0.497*** | 0.489*** | 0.487*** | 0.588*** | 1.798*** |
| | (0.169) | (0.172) | (0.169) | (0.128) | (0.227) |
| Total Score | 0.531*** | 0.522*** | 0.520*** | 0.628*** | 1.938*** |
| | (0.164) | (0.167) | (0.165) | (0.128) | (0.260) |
| Model | ITT | ITT | ITT | ITT | TOT |
| Child Controls | no | yes | yes | yes | yes |
| HH Controls | no | no | yes | yes | yes |
| District FEs | no | no | no | yes | yes |

Note: This table contains estimates of the effect of the program schools on test scores. In columns (1)-(4), the coefficients give the effect of the treatment on the indicated test score. In column (5), the coefficient is for enrollment, instrumented by the treatment status. Test scores are demeaned by the control-village mean, and divided by the standard deviation. The control variables are as given. All standard errors are clustered at the village level. Statistical significance at the one-, five-, and ten-percent levels is indicated by ***, **, and * respectively.

# Disaggregated Effects

- Differential enrollment effects by gender
  - Erases 5ppt gender gap at first follow-up
  - No differential effect in second year
    - No gender gap in controls either
- No consistent evidence of a differential effect on girls' test scores
- No effect for differentiated stipend
  - Overall or by gender

# Schools Characteristics

**Table 3: School Characteristics by Type of School**

| | PPRS Average (1) | PPRS - Public (2) | PPRS - Private (3) |
|---|---|---|---|
| School Surveyed | 0.945 | 0.699*** | 0.731*** |
| | | (0.051) | (0.072) |
| **Panel A: School Characteristics** | | | |
| Number of Days Open | 5.115 | 0.756** | 0.232 |
| Per Week | | (0.318) | (0.540) |
| Open Admissions | 0.88 | -0.023 | 0.018 |
| | | (0.047) | (0.100) |
| Uniform Required | 0.024 | 0.024 | -0.312* |
| | | (0.017) | (0.181) |
| Medium of Instruction | | | |
| Sindhi | 0.612 | -0.372*** | 0.02 |
| | | (0.050) | (0.179) |
| English | 0.31 | 0.310*** | -0.023 |
| | | (0.045) | (0.177) |
| Staffing | | | |
| Number of Teachers | 3.782 | 0.953*** | -2.48 |
| | | (0.315) | (1.860) |
| Number of Female Teachers | 1.986 | 1.480*** | -3.453** |
| | | (0.202) | (1.529) |
| Number of Teacher with Post-Secondary Degree | 1.898 | -0.454 | -1.675** |
| | | (0.458) | (0.820) |
| Number of Teachers '( 5 Years Experience | 3.132 | 2.503*** | 0.657 |
| | | (0.176) | (0.714) |
| Number of Teachers Between 5 and 10 years Experience | 0.603 | 0.413*** | -2.813 |
| | | (0.122) | (2.212) |
| Number of teachers ) 10 Years Experience | 0.047 | -2.004*** | -0.323 |
| | | (0.295) | (0.366) |
| **Panel B: Building Characteristics** | | | |
| School is in a Building | 0.965 | 0.01 | -0.035* |
| | | (0.033) | (0.020) |
| Number of Class Rooms | 3.229 | 0.482 | 0.115 |
| | | (0.337) | (0.925) |
| School Has Enough Desks | 0.805 | 0.205** | 0.166 |
| | | (0.098) | (0.175) |
| School Has Potable Water | 0.886 | 0.343*** | -0.114*** |
| | | (0.104) | (0.031) |
| School Has Electricity | 0.767 | 0.127* | -0.024 |
| | | (0.068) | (0.141) |
| School Has Toilet | 0.849 | 0.342*** | 0.195 |
| | | (0.114) | (0.167) |

| | PPRS Average (4) | PPRS - Public (5) | PPRS - Private (6) |
|---|---|---|---|
| **Panel C: Teacher Characteristics** | | | |
| Days Absent in Last Month | 0.838 | -0.138 | 0.249 |
| | | (0.311) | (0.266) |
| Female | 0.492 | 0.253*** | -0.04 |
| | | (0.074) | (0.175) |
| Age | 25.173 | -13.980*** | -0.365 |
| | | (1.398) | (1.438) |
| Years of Education | 10.967 | -0.961*** | -0.948*** |
| | | (0.186) | (0.276) |
| Monthly Salary | 4.066 | -11.777*** | 0.386 |
| (Thousands of Pakistani Rupees) | | (1.130) | (0.532) |
| Years of Experience | 2.784 | -11.660*** | -0.565 |
| | | (1.452) | (0.730) |
| Years at Current School | 1.774 | -5.261*** | -0.874 |
| | | (1.028) | (0.683) |
| Break Down of Weekly Teaching Time | | | |
| Total Hours | 25.191 | -0.53 | -1.312 |
| | | (2.088) | (1.228) |
| Teaching Full Class | 5.236 | 0.166 | 0.799 |
| | | (0.776) | (0.788) |
| Teaching Students in Small Groups | 3.927 | 0.492 | 0.199 |
| | | (0.368) | (0.674) |
| Teaching Individiual Children | 3.736 | -0.233 | 0.078 |
| | | (0.408) | (0.615) |
| Dictating Notes to Class | 3.619 | 0.318 | 0.675 |
| | | (0.511) | (0.501) |
| Time Spent on Discipline | 2.192 | -0.149 | -0.717** |
| | | (0.208) | (0.336) |
| Administering Tests | 2.424 | 1.011*** | 0.702* |
| | | (0.334) | (0.374) |
| Administrative Responsibilities | 2.026 | -0.321 | 0.477* |
| | | (0.441) | (0.288) |

# Structural Estimation

# Four steps

1. Using information about the choices of every household in our survey, we estimate demand for school characteristics using a logit discrete choice model.
2. We use these estimates to bound the costs of providing school characteristics. The intuition is that for schools that provide a given characteristic, the benefit in terms of additional enrollments – which can be computed in equilibrium using the demand model and information on competing schools – must have exceeded the cost of that characteristic; while, for schools without that characteristic, the opposite is true. The two inequalities provide bounds on the cost of that characteristic.
3. We estimate a structural education production function relating school and student characteristics to test scores.
4. Social planner: Entrepreneurs are only compensated on the basis of enrollments, while the social value of program also includes surplus accruing to students and the social value of education, we compute the optimal set of school characteristics that a social planner would have chosen.
    - The social planner solution includes consumer and producer surplus, and social value of education (in terms of higher future wages and externalities)

# Private Solution: demand side

- We estimate a demand function, based on the characteristics of the school (X).
- We estimate a logit random utility model: each student i, in school J, with characteristic X, have a utility function

$$u_{ij} = X_{ij}\beta + \epsilon_{ij},$$

- Student characteristics: gender, age, distance from house to the school, and several interactions between gender and school characteristics.
- School characteristics are whether there is an indoor toilet, drinking water, and electricity; teacher characteristics, including experience, gender, time spent teaching, and frequency of absence from the classroom
- The demand parameters capture families willingness-to-pay for various schools characteristics.

Table 12. Demand Estimation

| Characteristics | Coefficient |
|---|---|
| Constant | 1.132767*** |
| | (0.160341) |
| Toilet | 0.013525 |
| | (0.068417) |
| Drinking Water | 0.480188*** |
| | (0.072706) |
| Electricity | -0.217252*** |
| | (0.048806) |
| Student Female | -0.350614*** |
| | (0.088278) |
| Student Age | 0.033035*** |
| | (0.014525) |
| Distance | -0.065465*** |
| | (0.045696) |
| Pct Less Five Exp | -0.111607*** |
| | (0.087043) |
| Pct More Ten Exp | 0.748354*** |
| | (0.122299) |
| Pct Post Secondary | 0.005158 |
| | (0.07285) |
| Pct Teacher Female | -0.741559*** |
| | (0.067271) |
| Pct Time Teaching | 0.482434*** |
| | (0.150379) |
| average teacher absent >=4 days | 0.051904 |
| | (0.066665) |
| Female x Pct Teachers Female | 0.579934*** |
| | (0.098861) |
| Female x Distance | -0.136973*** |
| | (0.06667) |
| Female x Toilet | 0.179672*** |
| | (0.08816) |
| Government School | -1.866279*** |
| | (0.107811) |
| Cost Per Year | -0.013647*** |
| | (0.001444) |

Note. The table presents the coefficients from logit discrete choice model.

# Private Solution: supply side

- We use the demand curve to estimate bounds on the cost of providing school characteristics.
- We focus on characteristics which are under the control of the entrepreneur: drinking water, toilets, the percentage of female teachers in the school, percentage of more educated teachers, and whether teachers are chronically absent.
- We assume that schools will provide a characteristic, such as drinking water, if its cost does not exceed the additional revenue, through increased enrollments, that it generates. Likewise, for schools that do not provide the amenity, the opposite must be true. These two inequalities bound the cost of the amenity
- This exercise requires the use of the structural model, since we need to recalculate the expected distribution of students across schools under a counterfactual set of characteristics not observed in the data. Our demand model will also correct for the fact that in areas with competing schools, providing an additional amenity may not be as profitable as in other areas

# Costs (Table costs)

Table 14: Cost Estimates

| | |
|---|---|
| Water | 3.576263*** |
| | (0.217775) |
| Toilet | 0.763422*** |
| | (0.081950) |
| Female Teacher | -4.120795*** |
| | (0.529212) |
| Post-Secondary | 0.226161*** |
| | (0.144833) |
| Less than 5 Yrs Experience | -1.536237*** |
| | (0.293659) |
| Absent More Than Four Days | 0.736287*** |
| | (0.129540) |

Notes. This table presents the calculation for the (bounded) costs of the demand and supply model

- Running water is demanded uniformly by both male and female students,
- Toilet is demanded positively by female students.
- Teacher gender: The estimate reflects the cost of replacing a male teacher with a female teacher.
  - Male students react negatively to the presence of a female teacher (the opposite for female students). In combination with the number of boys and girls in each village, the sum of these forces implies that enrollment decreases when the program schools substitute a female teacher for a male teacher.
  - Female teachers must be less costly than their male counterparts: Male teachers are civil servants with relatively high salaries and stability (Andrabi et al. 2008). Moreover, Andrabi et al. 2008 documents that female teachers in private schools earn 33% less in than a male teacher in public schools (after controlling for other characteristics).
- Adding an additional teacher with a post-secondary education is costly (vis-à-vis a teacher with less than post-secondary education), as is decreasing the number of teachers that miss more than four days of school per month .
- Increasing the number of teachers with less than five years of experience reduces costs (in comparison to teachers with more than five tears of experience)

# Social Planner versus Private Solution

- The first order condition for a private solution:

$$pq'(x) - c'(x) = 0$$

- The first order condition for a social planner solution:

$$pq'(x) - c'(x) + h'(x) = 0$$

- The difference is the (marginal) social value

# Social Planner Problem

- $\max_{x} CV(x) + \pi(\mathrm{x}) + h(x)$

- Where CV is the consumer surplus (consumer variation), $\pi(\mathrm{x})$ is the producer surplus and $h(x)$ is the social value of education
-

# Consumer surplus

- Used the demand model to estimate the compensated variation

$$CV_i = \frac{\left(\gamma + \ln\left(1 + \sum \exp(\delta_{ij}(x))\right)\right)}{\alpha}$$

- Where $\delta_{ij}(x)$ is the deterministic component of utility from the logit model

# Producer Surplus

- The Producer Surplus is the difference between revenue (given by the enrollment times subsidy) and costs (estimated using the demand-supply model).

# Social Value

- The social value has two elements: the future (marginal) extra income gains due to education and any (positive) externalities.
- $h(x) = \tau g(x)$, where $g(x)$ is the education production function
- This specification assumes that social benefits of education are only a function of test scores, and $\tau$ captures the marginal (social) utility of increasing test scores.
- We assume that all the extra income gain comes from higher test scores, and in turns, higher test scores represents additional years of education
  - We use estimates of (yearly) returns to years of education (Mongenegro and Patrinos, 2014): a low and high bound [6.8%, 10.8%]
  - We use the estimation of Bau and Das (2017) of an additional year of education in Pakistan is associated with a test score improvement of approximately 0.40 standard deviations
- Then, and using a model of test scores based on the critical characteristics included in the demand side, we estimate the average change in (future) wages, given the baseline wage and participation rate observed now with survey data.

$$\Delta wage_{gb} = bl\_wage_g * \left(\frac{z\_score(test)}{0.40}\right) * \%\Delta wage_b * participation\_rate_g$$

- Externalities: we scale this estimate $h(x)$ by a constant.

Table 13. Education Production Function. Dependent Variable: standardized Total Score

| School Input | (1) | (2) | (1) | (2) | (1) | (2) |
|---|---|---|---|---|---|---|
| Toilet | 0.234** | 0.151* | 0.277*** | 0.128 | 0.234** | 0.148* |
| | (0.094) | (0.084) | (0.104) | (0.091) | (0.094) | (0.080) |
| Drinking Water | 0.146 | 0.161 | 0.144 | 0.168* | 0.141 | 0.123 |
| | (0.104) | (0.099) | (0.107) | (0.099) | (0.105) | (0.099) |
| Student Female | -0.068 | -0.046 | -0.053 | -0.035 | -0.068 | -0.048 |
| | (0.049) | (0.051) | (0.051) | (0.052) | (0.048) | (0.049) |
| Student Age | 0.100*** | 0.098*** | 0.099*** | 0.097*** | 0.100*** | 0.098*** |
| | (0.012) | (0.012) | (0.013) | (0.012) | (0.013) | (0.012) |
| Tuition required | 0.048 | -0.003 | -0.037 | 0.078 | 0.035 | -0.072 |
| | (0.112) | (0.113) | (0.167) | (0.180) | (0.132) | (0.167) |
| Distance | -0.010 | -0.013 | -0.008 | -0.012 | -0.009 | -0.004 |
| | (0.043) | (0.032) | (0.042) | (0.030) | (0.044) | (0.028) |
| Pct Less Five Exp | 0.316* | 0.359** | 0.333** | 0.336** | 0.307** | 0.300* |
| | (0.161) | (0.173) | (0.161) | (0.168) | (0.154) | (0.163) |
| Pct More Ten Exp | 0.269 | 0.300 | 0.192 | 0.356 | 0.316 | 0.554 |
| | (0.197) | (0.214) | (0.267) | (0.270) | (0.355) | (0.340) |
| Pct Post Secondary | 0.170 | 0.010 | 0.162 | 0.005 | 0.172 | 0.014 |
| | (0.118) | (0.102) | (0.124) | (0.109) | (0.119) | (0.103) |
| Pct Teacher Female | 0.139 | 0.017 | 0.137 | 0.019 | 0.138 | 0.003 |
| | (0.103) | (0.097) | (0.105) | (0.097) | (0.102) | (0.093) |
| Pct Time Teaching | -0.196 | 0.086 | -0.133 | 0.127 | -0.192 | 0.111 |
| | (0.314) | (0.352) | (0.341) | (0.400) | (0.315) | (0.349) |
| average teacher absent >=4 days | -0.147* | -0.192** | -0.153* | -0.190* | -0.150* | -0.214** |
| | (0.086) | (0.096) | (0.085) | (0.099) | (0.085) | (0.097) |
| Female x Pct Teachers Female | 0.071 | 0.096 | 0.071 | 0.090 | 0.072 | 0.100* |
| | (0.060) | (0.059) | (0.061) | (0.059) | (0.060) | (0.056) |
| Female x Distance | 0.005 | -0.019 | -0.000 | -0.018 | 0.006 | -0.013 |
| | (0.017) | (0.017) | (0.018) | (0.017) | (0.019) | (0.015) |
| Female x Toilet | 0.017 | -0.017 | 0.005 | -0.026 | 0.016 | -0.020 |
| | (0.065) | (0.063) | (0.068) | (0.064) | (0.065) | (0.061) |
| PPRS School | | | -0.106 | 0.087 | | |
| | | | (0.160) | (0.168) | | |
| Government School | | | | | -0.055 | -0.312 |
| | | | | | (0.296) | (0.291) |
| R-squared | 0.127 | 0.203 | 0.127 | 0.204 | 0.127 | 0.207 |
| N | 5381 | 5381 | 5332 | 5332 | 5381 | 5381 |
| District Fixed Effects | no | yes | no | yes | no | yes |

Note: This table presents the coefficient of a regression of total test scores (standardized) against the included school's characteristics. Columns (1): model do not control for district fixed effects; Columns (2): model controls for district fixed effects

# Social Planner Problem

- $\max_{x} CV(x) + \pi(\mathrm{x}) \ + h(x)$

- This problem is non-convex, due to the presence of discrete variables.
- We solve this problem by exhaustively computing all outcomes for all possible school combinations.
- The structural model allows us to solve for enrollments, educational outcomes, and profits for every possible configuration of program school characteristics.
- We assume that the characteristics of the other schools remain constant as the program school's characteristics change.
  - We think this is reasonable, as the primary competition for most program schools are government schools, which did not adjust across program and treatment villages

Table 15. Social Planner Solution

| | Private Observed | Social Planner Solution | | | |
|---|---|---|---|---|---|
| **Characteristic** | **Mean** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| Toilet | 0.82 | 1.00 | 0 | 1 | 1 |
| Drinking Water | 0.87 | 1.00 | 0 | 1 | 1 |
| Pct. Female Teachers | 0.48 | 0.68 | 0.3 | 0 | 1 |
| Pct. Teachers with Post-Secondary Education | 0.48 | 1.00 | 0 | 1 | 1 |
| Pct. Teachers with Less than Five Years Experience | 0.85 | 1.00 | 0 | 1 | 1 |
| Pct. Teachers Absent Four or More Days per Month | 0.15 | 0.00 | 0 | 0 | 0 |
| Change test scores | | 1541 | 645 | 208 | 3046 |
| Change in cost | | -635 | 603 | -3175 | 285 |
| Change in consumer surplus | | 9972 | 4508 | 1245 | 20242 |
| Change in enrollment | | 47.14 | 20.56 | 6.26 | 98.19 |
| Change in income (upper bound) | | 1304107 | 570427 | 187528 | 2503614 |
| Change in income (lower bound) | | 821104 | 359157 | 118073 | 1576350 |
| Total surplus (upper bound) | 1,345,777 | 1477147 | 627335 | 240016 | 2809626 |
| Total surplus (lower bound) | 908,068 | 994144 | 416418 | 169630 | 1882361 |

Note: This table presents the social planner solution and the observed private solution

# Social Planner vis-à-vis Private Solution

- The entrepreneurs have proven remarkably successful at setting up schools that generate most of the possible surplus in the environment.
  - The social planner's solution generates gains of slightly more than ten percent relative to the observed equilibrium.
- The social planner achieves these increases through a variety of changes to program schools. Under the social planner:
  - All program schools have a toilet and have running water, an increase of 18 percent and 13 percent over the baseline, respectively.
  - Exclusively employs teachers with post-secondary education (+52 percentage points), with less than five years of experience (+15 percentage points), and imposes that no teachers are absent more than four days per month (-15 percentage points).
  - The social planner employs 68 percent female teachers (+20 percent points), but this mask substantial heterogeneity. In some schools, the social planner assigns either zero female teachers or all female teachers. This is driven by differences in the composition of the underlying student demographics—in villages with many boys and few girls, enrollments, and subsequently test scores, will suffer if the school employs female teachers. The opposite is true in villages with relatively many girls.
- On average, the social planner chooses characteristics that lower costs.
  - Driven by the employment of female teachers
  - While total costs decrease, test scores increase dramatically.
  - This results from both higher enrollments under the social planner, averaging 47 more students attending school, and better learning outcomes resulting from the interactions among teachers, school characteristics, and students. The better match quality between students and schools is reflected in the gains to consumer surplus, which are large and uniformly positive across all villages.
  - Finally, there are substantial income effects due to increased educational outcomes, which directly translates into higher social welfare.

# Conclusion

- We find that the entrepreneurs did remarkably well in choosing school characteristics, capturing approximately 90 percent of the total amount of possible surplus.
- The primary differences between the program schools and the social planner's solution are the latter's mandating of toilets and running water, and a shift towards the use of teachers that are gender-matched to the underlying demographic distribution of students.

# Other tables

# Data Collection

- Baseline/Vetting: April 2009
  - Used for vetting
  - Two samples:
    - Children from households that committed to attend
    - All children in the village
  - Problems with the survey
    - Sampling was not well performed, but was consistently performed
    - Insufficient identifying information collected to allow matching to later survey rounds
- Follow-up 1: Summer 2010
  - Complete census of villages
  - Basic socio-demographic questions on family and household head
  - Self-reported enrollment

# Data Collection

- Follow-up 2: April/May 2011
  - Census in most villages
    - Subsample of very large villages, based on census
  - Household survey
  - Math and language exams for all children between 5 and 10
  - School survey
    - Detailed information on schools, teacher characteristics

**Table 1: Sample Size**

| | Control | Treatment | | | Sample |
|---|---|---|---|---|---|
| | | Total | Regular | Incentive | Total |
| | (1) | (2) | (3) | (4) | (5) |
| Number of Villages | 38 | 161 | 82 | 79 | 199 |
| Baseline Survey | | | | | |
| Households | 445 | 1644 | 823 | 821 | 2089 |
| Children | 1141 | 4415 | 2261 | 2154 | 5556 |
| First Follow-Up Survey | | | | | |
| Households | 1530 | 7109 | 3795 | 3314 | 8639 |
| Children | 4567 | 20591 | 11231 | 9360 | 25158 |
| Second Follow-Up Survey | | | | | |
| Households | 1069 | 4897 | 2594 | 2303 | 5966 |
| Children | 3093 | 14627 | 7717 | 6910 | 17720 |

Note: This table contains the tabulation of the sample used for the study, divided by survey round and research group.

# Internal Validity

- Baseline data allows assessment of sample at randomization
- Differential attrition
  - Can't use baseline because of matching problems
  - Use demographic characteristics from follow-up surveys
- The groups are balanced for each survey round
  - Only consistent difference is a 3-4 percent difference in fraction of girls
- Implied differences in predicted enrollment at each follow-up are all between 2-3 percentage points

# Treatment Differential

- Second-year follow-up school census
- Data on three sets of characteristics:
  - Characteristics of the school
    - Medium of instruction, enrollment, etc.
  - Physical characteristics
  - Teacher characteristics
- Results
  - Primary alternative to PPRS is public schools
    - 5 percent of children attend other schools
  - Treatment villages
    - English medium
    - Better resourced
    - More female, younger, and less experienced teachers

# Families' Aspiration

- Second follow-up survey
- Asked several questions regarding parents' preferences for each child
  - Ideal age at marriage
  - Ideal level of education
  - Preferred Occupation
- Results
  - Find the expected gender gaps for each question
  - PPRS increases the desired years of education by 1.5 years
  - Parents more likely to want boys to become a doctor or engineer
  - For girls, parents less likely to want them to become housewife, more likely to want them to become teachers, doctors, engineers

**Table 10: Child Aspirations**

| | Control (1) | Treat-Control (2) | Female (3) | Treatment (4) | Treat X Female (5) |
|---|---|---|---|---|---|
| married | 0.014 | -0.006 | -0.001 | -0.008 | -0.001 |
| | | (0.005) | (0.006) | (0.006) | (0.007) |
| ideal marriage age | 18.496 | 0.251 | -1.019** | 0.332 | -0.169 |
| | | (0.440) | (0.413) | (0.456) | (0.448) |
| **Parental Preferences for Children:** | | | | | |
| Civil Servant | 0.127 | 0.031 | -0.06 | 0.05 | -0.027 |
| | | (0.036) | (0.047) | (0.048) | (0.049) |
| Doctor | 0.082 | 0.048*** | -0.005 | 0.058*** | -0.025 |
| | | (0.018) | (0.022) | (0.019) | (0.025) |
| Private Sector | 0.024 | -0.005 | -0.019** | -0.009 | 0.012 |
| | | (0.012) | (0.009) | (0.015) | (0.011) |
| Engineer | 0.014 | 0.024*** | -0.014** | 0.026*** | 0.004 |
| | | (0.007) | (0.007) | (0.009) | (0.011) |
| Farmer | 0.105 | -0.044* | -0.144*** | -0.06 | 0.055 |
| | | (0.025) | (0.031) | (0.038) | (0.035) |
| Housewife | 0.179 | -0.048** | 0.409*** | -0.003 | -0.146*** |
| | | (0.023) | (0.043) | (0.010) | (0.049) |
| Laborer | 0.028 | -0.01 | -0.023** | -0.004 | -0.001 |
| | | (0.008) | (0.010) | (0.010) | (0.011) |
| Landlord | 0.013 | 0.004 | -0.017* | 0.004 | 0 |
| | | (0.006) | (0.009) | (0.010) | (0.010) |
| Lawyer | 0.004 | 0.009*** | -0.007** | 0.009* | 0.002 |
| | | (0.003) | (0.003) | (0.005) | (0.005) |
| Police/army/security | 0.098 | -0.031 | -0.101*** | -0.050* | 0.041* |
| | | (0.020) | (0.022) | (0.026) | (0.023) |
| Raise livestock | 0.018 | -0.009 | 0.002 | -0.007 | -0.008 |
| | | (0.011) | (0.012) | (0.010) | (0.012) |
| Teacher | 0.247 | 0.027 | 0.025 | -0.012 | 0.079** |
| | | (0.028) | (0.029) | (0.025) | (0.035) |
| Ideal Education | 7.429 | 1.537** | -0.830** | 1.462** | 0.245 |
| | | (0.606) | (0.395) | (0.682) | (0.458) |
| **Child's Preferences** | | | | | |
| Ideal Jobs: | | | | | |
| Army | 0.083 | -0.031 | -0.085 | -0.068 | 0.055 |
| | | (0.044) | (0.060) | (0.098) | (0.066) |
| Doctor | 0.224 | 0.03 | -0.027 | 0.093 | 0.067 |
| | | (0.055) | (0.093) | (0.074) | (0.108) |
| Farmer | 0.019 | -0.017 | 0.011 | -0.027 | -0.016 |
| | | (0.013) | (0.054) | (0.033) | (0.055) |
| Government | 0.028 | 0.041** | 0 | 0.121*** | -0.112*** |
| | | (0.021) | (0.000) | (0.034) | (0.036) |
| Other | 0.068 | -0.008 | -0.093 | 0.002 | 0.064 |
| | | (0.052) | (0.079) | (0.084) | (0.084) |
| Private sector | 0.169 | -0.004 | -0.007 | -0.064 | 0.084 |
| | | (0.068) | (0.131) | (0.099) | (0.146) |
| Teacher | 0.379 | -0.003 | 0.301** | 0.034 | -0.239 |
| | | (0.085) | (0.149) | (0.128) | (0.165) |
| Desired Education | 11.312 | -0.264 | -0.141 | -0.286 | 0.28 |
| | | (0.366) | (0.357) | (0.589) | (0.444) |