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

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Abstract: We evaluate the effects of publicly funded private primary schools on child enrollment in a sample of 199 villages in 10 underserved districts of rural Sindh province, Pakistan. The program entailed the creation of new schools by private entrepreneurs, with the aim of leveraging market mechanisms and local knowledge for the improvement of educational outcomes while keeping costs low. The schools were open to all students of primary school age within the village at no cost. The evaluation is based on the random allocation of new schools at the village level. The program increases child enrollment by 30 percentage points in treated villages for both boys and girls. We find no evidence that providing greater financial incentives to entrepreneurs for the recruitment of girls leads to a greater increase in female enrollment than does an equal compensation scheme for boys and girls. Test scores improve dramatically in treatment villages, rising by 0.67 standard deviations relative to control villages. Test scores suggest the program schools have higher educational productivity than government schools, with students scoring 0.16 standard deviations higher, despite coming from socio-economically marginalized households. A structural model of supply and demand suggests that entrepreneurs provide nearly-efficient levels of school characteristics.

Keywords: Primary Education; Public-Private Partnership; private schools; subsidies; Pakistan; competition; Randomized-controlled trial

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1 Introduction

Developing countries face the dual challenges of increasing enrollment rates while improving student achievement. Though considerable progress has been made in recent years in raising primary education levels, low enrollment rates persist in regions such as Sub-Saharan Africa, West and Southwestern Asia, and South Asia (Hausmann, Tyson, and Zahidi, 2011). Compounding this failure, learning outcomes in many developing countries remain dismally low (Pritchett, 2013). In the face of these challenges, many governments have acknowledged their ineffectiveness in directly providing certain populations with government-operated schools, and are increasingly resorting to partnership with private schools to increase access and efficiency. This paper evaluates a novel variant of a public-private partnership (PPP) that was implemented in the Sindh province of Pakistan with the intent to improve enrollment and learning outcomes in a cost-effective manner.

The intervention we evaluate, called the Promoting Low-Cost Private Schooling in Rural Sindh (PPRS) program, entailed the provision of schools through public-private partnerships to 161 villages randomly chosen from a sample of 199 qualifying locales. Private entrepreneurs were given the responsibility of establishing and operating primary schools. All local children between the ages of 5 and 9 were eligible for free enrollment, and entrepreneurs received a per-child subsidy from the Sindh provincial government.

A central challenge in the pursuit of universal enrollment is the inequality in educational opportunity between boys and girls. It is estimated that women constitute two-thirds of the world's illiterate adults and 54 percent of un-enrolled school-age children (UNESCO, 2012). Related to the gender gap is the rural-urban divide in educational opportunity: within developing countries, enrollment rates in rural areas tend to lag those in urban locations (UN, 2008a), with the gender disparity in enrollment being driven primarily by inequalities in rural areas (UN, 2008b). While gender disparities in enrollment are often attributed to a lower parental demand for female-child education, supply factors have also been found to play a significant role, with girls having important economic responsibilities within the household, or facing additional physical insecurities in transiting to-and-from school.[1] To understand this issue better, our intervention includes a

[1] With girls playing a larger role in domestic work than boys, the opportunity cost of female enrollment is higher than that of males, potentially contributing to educational disparities. Consistent with this, Glick and Sahn (2000) find that domestic responsibilities, represented by the number of very young siblings, have a strongly adverse effect on girls' enrollment but not on boys'. Similarly, Pitt, Rosenzweig, and Hassan (1990) find that daughters are more likely to increase their time in household work relative to school than their brothers in response to a younger sibling's illness. Females may be deemed more at risk of physical harm than males, thereby posing either a psychological cost for parents of allowing their daughters to walk long distances, or a pecuniary cost if this induces parents to pay for transportation. Consistent with this, several papers find that the distance to school appears to be a more significant deterrent to girls' enrollment than boys' (Alderman, Orazem, and Paterno, 2001; Lloyd, Mete, and Sathar, 2005; Burde and Linden, 2013).

second treatment arm: half of program villages are assigned a gender-differentiated subsidy scheme, whereby entrepreneurs receive a higher per-student subsidy for girls than for boys.

This program represents a novel variant on traditional PPP initiatives. Whereas other PPP programs have generally made use of private schools already operating in the market, the PPRS program instead required the creation of new private schools. Consequently, the program had the effect of both expanding educational access in these villages, and creating private competition in the local education market. The analysis presented in this paper, therefore, speaks not only to the general literature on the difference in the quality of education provided by private and public schools, but also facilitates a closer examination of the mechanisms by which private actors accomplish these efficiencies, and the estimation of how near they come to achieving the social planner's solution. underlying market mechanisms that drive school characteristics and quality in equilibirium.

The relative effectiveness of public versus private schools has been the subject of a substantial empirical and theoretical literature. The arguments for the virtues of the private provision of education are intuitive and familiar (Friedman, 1955; MacLeod and Urquiola, 2012), and have received some empirical validation (Hoxby, 2003; Muralidharan and Sundararaman, 2015).[2] The purported "private advantage," however, requires qualification, as an empirical literature on voucher programs in the US has yielded more mixed results on the quality differential of private schools (e.g., see the review by Epple, Romano, and Urquiola, 2015), while theoretical considerations suggest private schools may merely increase students sorting without improving educational outcomes (Hsieh and Urquiola, 2006). We contribute to this literature in two ways. First, an important element of our intervention is that entrepreneurs have substantial latitude to tailor the characteristics of their schools and hire teachers as they see fit. In conjunction with our randomized research design, this allows us to peer inside the "black box" of private schooling to evaluate how private schools improve educational outcomes. Second, by comparing the enrollment patterns of students across the program and treatment villages, while controlling for changes in the quality of the schooling available to them, we are able to separate sorting and productivity effects.

The PPRS program was found to be highly effective, both in terms of enrollment and student achievement. The introduction of program schools leads to large gains in enrollment: overall, treatment villages experience a 30 percentage point increase in enrollment for children within the target age group, and a 12 percentage point increase in enrollment for older children. Test scores increase by 0.67 standard deviations in treatment villages, and by 2.01 standard deviations for children induced to enroll by the introduction of program schools. These effects are the same for boys and girls; and the subsidy providing enhanced compensation for

[2] Hoxby (2003) gives a review of this literature. Muralidharan and Sundararaman (2015) study a voucher experiment, and find that private schools are both highly cost-effective and also have greater flexibility in tailoring education to the specific preferences of the families they service.

girls shows no greater effectiveness in inducing female enrollment than the equal-valued subsidy. Parents in treatment villages are far more likely to report a preference that their boys have future careers as doctors and engineers, rather than as security personnel; and that their girls become doctors, engineers, and teachers, rather than housewives.

Evidence for the quality advantage of private schools can be found in the superior educational performance of children enrolled in program schools in comparison to those enrolled in government schools, who score 0.16 standard deviations higher on their exams, despite coming from worse socio-economic backgrounds. This assessment is further bolstered by the estimated parameters of the education production function, which demonstrate the efficacy of precisely those school characteristics consistently selected by the program entrepreneurs, but which are less prevalent in government schools.[3] In addition to these reduced form comparisons, our setting allows a more general assessment of the efficiency of the newly-created education market by a comparison of the program schools with the characteristics that would been selected as the solution of the social planner's problem. For this purpose, we pose and estimate a structural model of supply and demand, and use this to both estimate how the intervention changed the market equilibrium and to assess the efficiency of the observed configurations of program schools chosen by entrepreneurs.

The estimation of the structural model proceeds as follows. First, using information about the choices of every household in our survey, we estimate a logit demand model for school characteristics. Second, 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. Third, we estimate an education production function relating school and student characteristics to test scores. Motivated by the observation that school entrepreneurs are only compensated on the basis of enrollments, while the social value of the program also includes the 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.

Employing this procedure, 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 for all schools, and a shift towards the use of teachers that are gender-matched to the underlying demographic distribution of students.

[3] As we show subsequently, these parameters are stable even when including a dummy variable for program schools.

2 Pakistan and the PPRS Program

2.1 Education in Pakistan

School participation is low in Pakistan, even in comparison with countries having a similar level of economic development (Andrabi, Das, and Khwaja, 2008).[4] Nationwide, the primary school net enrollment rate[5] for children ages 5-9 is 56%: 60% for males and 51% for females. These national averages subsume large regional disparities: in the poorer, more rural provinces, net enrollment rates are lower for both sexes, and gender disparities higher. In the rural areas of Sindh province, for example, where the program was implemented, only 49% of males and 31% of females between the ages of 5 and 9 are enrolled in primary school (PSLM, 2007).

Countries such as India and Pakistan have witnessed a dramatic growth in private schooling. Pakistan, for example, experienced a 46% increase in the number of private schools, growing from 32,000 schools in 2000 to 47,000 schools in 2005, and a concomitant increase in private school enrollment. By 2005, one out of every three enrolled children in Pakistan was studying in private school (Andrabi, Das, and Khwaja, 2008).

In a stark departure from earlier patterns, where private schools once primarily serviced the economic elite, much of the expansion in recent decades has occurred in poor urban and rural communities. Nearly half of all new private schools set up in Pakistan since 1995 have been in rural areas; and, by 2005, one in every six children from the poorest 20% of the population in Pakistan attended a private school. These schools have, remarkably, succeeded along dimensions of both cost and quality: at an average $18 per year in villages, the cost represents a small fraction of household income (Andrabi, Das, and Khwaja, 2008);[6] while student achievement levels have been better than in government schools, even when controlling for village and household characteristics (Das, Pandey, and Zajonc, 2006).

There continue to exist large disparities, however, in the prevalence of private schooling across the provinces of Pakistan. In villages with private schools in Punjab province, 23% of children enrolled in primary school were in private schools, while only 11% of those in villages lacking private schools were so enrolled. In Sindh province, in contrast, the private enrollment rates were 5% and 2%, respectively.

[4] Using a simple regression of the net-enrollment rate on log per-capita income and its square for 138 countries, the authors show that the Pakistan's predicted net-enrollment rate is 77%, but its actual rate only 51%.

[5] Net enrollment is defined as the number of children aged 5 to 9 years attending primary level divided by the number of children aged 5 to 9.

[6] The cost-effectiveness of these schools is attributable largely to their ability to recruit local women as teachers, to whom significantly lower wages can be paid due to the scarcity of alternative employment options in rural areas.

2.2 PPRS Description

Sindh is Pakistan's second most populous province, but one where educational outcomes are poor, particularly in rural areas. Nearly 70% of Sindh's 5.5 million out-of-school children live in rural areas. The problem is especially severe for girls, with nearly 70% of girls in rural areas having never attended school. To address access, equity, and quality challenges, the Government of Sindh (GoS) is implementing the Sindh Education Sector Reform Program (SERP). The public-private partnership pilot is at the heart of the government's strategy embodied in the SERP to improve educational opportunities for children, and girls in particular, in rural areas.

The intervention was implemented by the Sindh Education Foundation (SEF), a semi-autonomous organization established in 1992 by the Sindh provincial government to undertake education initiatives targeting less-developed areas and marginalized populations within Sindh province. The Promoting Low-Cost Private Schooling in Rural Sindh (PPRS) program, evaluated in this paper, is a notable example of the SEF's innovative approach to extending educational access.[7] Leveraging the fore-mentioned advantages of private education, the program seeks to expand access to primary education in underserved rural communities through public-private partnerships with local entrepreneurs. In addition, through the submission of applications for villages they have identified as plausibly meeting the necessary criteria, the local entrepreneurs involved in the program play an important role in identifying the villages most in need of educational facilities.

The intervention of interest falls under the rubric of public-private partnerships (PPP) in education; here, it specifically entails the public financing of the private provision of primary education in underserved rural localities in the province of Sindh, Pakistan. In a departure from traditional PPP models, however, the entrepreneurs are also assigned the task of founding the private schools in which the target children are to enroll. The main stated program objectives are to (1) increase access to schooling in marginalized areas, (2) reduce the gender disparity in school participation, and (3) increase student learning and achievement. While the program is publicly financed, responsibility for the design and administration of the program lies with the Sindh Education Foundation (SEF).

The program was first implemented on a pilot basis in 8 (out of the 23) districts in the province; the pilot period is expected to last 3-4 years. The pilot districts were selected on the basis of how they ranked in terms of (1) the size of the out-of-school child population, (2) gender disparity in school participation, and (3) the share of households at least 15 minutes away from the nearest primary school—the 8 lowest-ranked districts were selected.

[7]Other SEF initiatives include supporting local communities in establishing and managing small schools; providing assistance to pre-existing low-cost private schools; enlisting the private sector for management of dysfunctional public schools; and promoting non-formal adult education.

In the pilot stage, SEF plans to support private primary schools (grades 1-5) in 200 rural localities (i.e., villages) in the 8 selected districts. The benefits that program schools are expected to receive comprise of (1) a per-student enrollment subsidy, (2) school administrator and teacher training, (3) free textbooks, and (4) the opportunity to improve the quality of educational services by seeking certification with SEF's Quality Assurance and Resource Center.

Two types of monthly per-student subsidies were tested: (1) a "Gender-uniform Subsidy," where the school receives 350 rupees (USD5.2) for each student, and (2) a "Gender-differentiated Subsidy," where the school receives 350 rupees for each male student and 450 (USD6.7) rupees for each female student. A total of 100 schools receive the gender-uniform subsidy in addition to the other listed benefits, and another 100 schools receive the gender-differentiated subsidy with the same additional benefits.

Interested parties were invited to apply to participate in the program, and propose rural localities in the pilot districts where they would like to set up and operate schools. These proposals were vetted according to several criteria: sufficient distance to the nearest school;[8] written assent from the parents of at least 75 children who would enroll their children in the program schools should they be established; and identification of qualified teachers, with at least two being female,[9] and an adequate facility in which to hold classes. Once applicants were selected into the program, conditions for continued eligibility for program benefits included, inter alia, (1) no tuition charges and (2) maintenance of infrastructural and environmental quality standards. After the first year of implementation, benefits were conditioned on the level of student academic performance in a periodic, externally-administered test.

3 Potential channels for effects

The PPRS program was motivated by the dual objectives of increasing student enrollment and achievement, while simultaneously keeping costs low. Though it was anticipated that locating zero-fee schools directly within these villages would be sufficient to increase enrollment, its efficacy in improving educational achievement was more uncertain. To tackle the challenge of ensuring that this education be of high quality and low cost, therefore, the program was implemented through private providers with government financial support, making use of the insights gained in recent years on the cost and quality advantages of private education in Pakistan (Andrabi, Das, and Khwaja, 2008).

In the basic human capital model (Becker, 1962), families compare all the present and future costs and

[8] There could be no primary school within a 1.5 kilometers radius of the proposed school site. However, due to problems with the baseline survey, a number of villages were included that failed this criterion.

[9] The teachers were required to have, at minimum, an 8th grade education. This was set at a sufficiently high level that the teachers would have competence in primary education-level subjects, but low enough that qualified local women could be found.

benefits of sending members of the family to schools. Along with the opportunity cost of foregone wages, education fees and transportation costs (both in time and direct payments) are among the more salient costs of attending school (Murnane and Ganimian, 2014). The program reduces the cost of transportation by situating schools within underserved localities, and reduces tuition costs by charging zero fees for enrollment.[10] The immediate consequence of these two changes should, in principle, be an increase in demand; and, consequently, higher rates of enrollment and attendance.

Evidence for the effects of distance on enrollment and attendance is fairly strong, both from experiments (Burde and Linden, 2013 in Afghanistan; Martinez, Naudeau, and Pereira, 2012 in Mozambique) and quasi-experiments (Foster and Rosenzweig, 1996 in India; Duflo, 2001 in Indonesia; Berlinski, Galiani, and Gertler, 2009 in Argentina).[11] All these studies show that when schools are built in underserved areas, the demand for schooling increases, often quite substantially.[12] Evidence for the effects of zero fees on demand for schooling is also strong, pointing to a clear gradient between price and enrollment (e.g., Deininger, 2003; Barrera-Osorio, Linden, and Urquiola, 2007; Lucas and Mbiti, 2012; Bold et al., 2014). This finding has been reinforced by the growing research on the effects of conditional cash transfer programs, which show a similar sensitivity in the price elasticity of enrollment (see the reviews of Fiszbein, Schady, and Ferreira, 2009; Saavedra and García, 2012).

Overall, these interventions have shown clear positive impacts on enrollment. In addition to the basic provision of new schools, the structure of the subsidy contains an additional supply-side element through the incentive provided to entrepreneurs to increase the attractiveness of their schools, as the total subsidy received is a linear function of the number of children enrolled. This feature is strengthened for girls' enrollment in the gender-differentiated subsidy villages, which could potentially incentivize entrepreneurs to undertake additional investments and actions or draw in more girls, for example through hiring female teachers, providing safe transportation and a safe schooling environment, or even offering a small stipend to girls.

The positive enrollment effects from interventions that reduce the cost of attending school stand in contrast to the mixed effects on achievement. Early evidence from CCT programs, for example, suggests that exposure to (more) schooling does not necessarily lead to higher student achievement (Fiszbein, Schady, and Ferreira, 2009; Saavedra and García, 2012). More recent evidence suggests positive effects on student achievement, though these results depend crucially on the specific design components of each individual

[10] The opportunity cost of foregone income is less salient in the context of this study, as these villages are too remote for substantial market income-generating opportunities.

[11] In contrast, Filmer (2007) finds little evidence that school access is important to enrollment rates. This study is not causal in nature, and is prone of endogeneity problems, as well as problems in the definition of the relevant distance.

[12] Some programs are proposing different strategies like provision of bicycles in India to reduce commute time to school (Muralidharan and Prakash, 2013).

program (Barham, Macours, and Maluccio, 2013; Barrera-Osorio and Filmer, 2015). To address the challenge of increasing student achievement, the program operates through private schools, under the hypothesis that the latter have more flexibility in the use of resources than public institutions, are better able to accommodate the specific demands of parents (Hoxby, 2003; MacLeod and Urquiola, 2012; Muralidharan and Sundararaman, 2015), and have greater accountability to the families that they serve (World Bank, 2004).

There is some evidence that children who attend private schools have better learning outcomes on average than those attending public schools, and that private provision may be more cost-effective than traditional public provision. A recent study in Punjab province in Pakistan, for example, found that children in public schools would require 1.5-2.5 years to catch up with learning levels achieved by grade 3 children in private schools (Andrabi et al., 2007). The estimation of the "private premium" is extremely difficult, however, due to a combination of self-selection into private institutions by families and the supply-side selection of students by schools (Macleod, , and Urquiola, 2009), which render it difficult to disentangle school productivity from student composition.

An important source of evidence for the private premium comes from the numerous voucher programs that have been conducted. Several studies set in developing countries have used quasi-experimental (Angrist et al., 2002; Angrist, Bettinger, and Kremer, 2006) and experimental designs (Muralidharan and Sundararaman, 2015) to answer this question. Angrist et al (2002, 2006) find a positive effect of private enrollment on a large array of outcomes, including both progression and achievement, though these effects confound private school production and incentives to students' effort.[13] A more recent evaluation in India (Muralidharan and Sundararaman, 2015) uses a two-stage randomization, at the village and household levels, to provide evidence both for the effects of attending a low-fee private school, and also the general equilibrium effects on students excluded from the program. In line with other research (for example, Hoxby, 2003), the paper finds that private schools are highly cost-effective in improving test scores;[14] and more responsive in tailoring pedagogy according to parental demands, reallocating time from subjects like reading and math towards English, Hindi, science and social studies. The paper finds no general equilibrium effects on student outcomes for those remaining in public schools within the program villages.

This paper also speaks to the literature on public-private partnerships in the education sector (Patrinos, Osorio, and Guáqueta, 2009). Though PPP programs share many of the theoretical implications found in the voucher literature (e.g, private premium and competition), there are important ways in which they

[13]In addition to enabling private school attendance, the program also stipulated that the child would lose his or her voucher in the event that his or her grades fell below a certain level.

[14]Test scores for Telugu and math remained the same, despite significantly less time being spent on these topics; while time allocated towards other topics yielded test score improvements.

differ. Most conspicuously, PPPs enable a better quality of education through the parameters of the contract between the private provider and the government, with some programs stipulating aspects of the quality of infrastructure and teachers, and others choosing participating schools based explicitly on their proven quality.

However, because public private partnership programs lack some of the strong, market-based accountability mechanisms that prevail in private schools (Barrera-Osorio et al., 2016), they may provide lower quality education than would have been accomplished by independent providers. Indeed, these programs may actually disrupt the price mechanism, hindering its power to inform market participants of the relative efficiencies of producers and the preferences of consumers (Hayek, 1945).[15]

As such, the effect of a PPP-based education on student achievement is theoretically ambiguous, and likely to depend crucially on the specific context. A recent literature has sought to shed empirical light on this matter, and has generally found these programs to have positive effects on achievement and enrollment (Kim, Alderman, and Orazem, 1999; Alderman, Kim, and Orazem, 2003; Barrera-Osorio and Raju, 2015; Barrera-Osorio et al., 2016). However, part of the effects on enrollment is due to potential displacement of students from public to private schools.

4 Experiment

4.1 Research Design

The program was first implemented on a pilot basis in 10 districts of Sindh province. These districts were chosen to participate due to their being the most deprived in terms of educational resources.[16] Interested entrepreneurs were encouraged to submit proposals for communities in which to establish schools, and had to demonstrate sufficient demand and the absence of a pre-existing school, the ability to recruit female teachers, and a facility in which to hold classes with the requisite amenities amenities. A total of 263 localities were deemed eligible, from which 200 were randomly selected to receive treatment. The 200 treatment villages were further subdivided equally by subsidy type.

A baseline survey was conducted in February 2009, for the purpose of vetting applications for final consideration. Following this, the 263 qualifying villages were randomly assigned to the two treatments and the control group, and the schools then established in the summer of 2009. Because the new school term normally commences in the spring, the students received an abbreviated term in their first year. An

[15] Though prices generated in the education market may obscure broader problems of limited information in education markets (MacLeod and Urquiola, 2012).

[16] Based on rankings determined by several indicators of educational deprivation – including the size of the out-of-school child population, the initial gender disparities in school participation, and the share of households at least 15 minutes away from the nearest primary school – the 10 lowest ranked districts were selected for participation.

initial follow-up survey was conducted in June 2010.[17] In April/May 2011, a second follow-up survey was conducted, which was significantly more extensive in scope than the first.[18]

Table 1 summarizes the sample sizes across the three surveys, disaggregated by treatment status. There were 199 villages included in our sample, with 82 and 79 in treatment groups 1 and 2, respectively, and 38 in the control group.[19] The baseline data from these 199 villages included 2,033 randomly selected households and 5,556 children.[20] In these villages there were 8,639 households with children between the ages of 5 and 15, and 25,157 children within this age group, as determined during the first follow-up survey, which consisted of a complete census of each village. From each village, up to 42 households were randomly selected for inclusion in the second follow-up survey; for villages with fewer than 42 households, which comprised the majority, all willing households were included in the second follow-up.[21] In total, 17,721 children between the ages of 5 and 17 were included in the follow-up survey.[22]

4.2 Data

In the baseline survey, basic child and household information was collected for 12 randomly selected households in each village.[23] Among the details recorded were: age, gender, and enrollment status of all children between the ages of 5 and 9; the profession and education of the household head; and the number of individuals within the household. Data was also collected on teachers and building facilities proposed by the entrepreneur, as well as the availability of proximate primary schools.

In the first follow-up survey, information was collected for all households in the villages. Information was collected on the age, gender, and enrollment status of all children between the ages of 5 and 15. The caste, profession, and education of the household head were collected, as well as the number of adults, the amount of land owned by the household, and the building material of the family's house.

The second follow-up survey consisted of three elements: (1) a household survey, which included socio-

[17]This consisted of a complete census of the villages. Because it occurred a year after commencement of the project, we employ the data collected as a follow-up survey.

[18]This survey was initially scheduled to commence just after the census. However, due to the widespread flooding occurring during in late-summer 2010, it was necessarily postponed.

[19]There were 237 villages for which data was collected in the baseline. An additional 38 villages were removed from the sample at the time of census due to their being too large to be considered villages.

[20]The method by which the baseline data was the "spin-the-bottle" technique, whereby 12 households were chosen based on their being along a straight line determined by a bottle spun in the center of the village. Though this is the approach adopted by many development organizations, it falls short of representing a truly randomly drawn sample, and as such the results must be used with caution. However, insofar as the technique was employed consistently across treatment groups, the populations should still be roughly balanced if the randomization has been successful.

[21]Only households with at least one child between the ages of 5 and 9 at the time of the first follow-up were included in the sample.

[22]During the second follow-up survey, the age range of children was extended to 17. The reason for this change was two-fold: (1) to ensure coverage of children who were included in the first follow-up, but may have aged out of the 5-15 range by the time of the second follow-up; and (2) because the age requirement was difficult to enforce, meaning older children were often enrolled in the program schools.

[23]The method of randomization was the "spin-the-bottle" technique.

economic questions on the household, a detailed module on child characteristics, parental preferences over various dimensions of the education of each young child, and questions on the characteristics of the schools in the village; (2) a school survey; and (3) a child survey, which included numeracy and literacy exams of 24 and 14 questions, respectively.

The household survey had three principal components. First, household-level characteristics were collected, covering details such as: the household head's profession and level of education; ownership of land, livestock, and other assets; income (both monetary and in-kind) and remittances; and attitude towards religion and social issues. Second, the respondent was asked the characteristics of every child in the house, covering items such as: age, gender, marital status, work within and outside the household, enrollment, and study habits. In addition, the respondent was asked their personal preference over the education of each child: for example, how important it is that the specified child receive instruction in topics such as mathematics and English, or that their teacher be female. Lastly, there was a school module, in which the respondent was asked to describe the characteristics of each school near to the village, and to rank them according to these characteristics.

The child survey was administered to each child between the ages of 5 and 10. A few basic questions were asked of the child regarding types of work done inside and outside the home, enrollment status, and their desired adulthood professions. Each child was then administered a language exam, consisting of 14 questions, and a math exam, with 24 questions.

The third element was the school survey. The headmaster provided information on various school characteristics such as: the number of years the school had been operational, its daily schedule, and the medium instruction; the overall characteristics of teachers at the school, including the number that are female, their educational qualification, and years of experience; and class sizes, tuition, and other fees. Through visual inspection, the enumerators established the physical characteristics of each school, covering the number of classrooms, desks, electrification, drinking water, and toilet facilities. In addition, each teacher was individually interviewed, with information being gathered on their age, teaching experience, educational qualifications, and salary; as well as the number of hours spent each week on different teaching activities, such as teaching small groups and individuals, administering exams, and enforcing discipline. Finally, attendance was taken of each class, with the attendance lists to be used during conduct of the household survey to verify child enrollment.

4.3 Statistical Models

The principal outcomes of interest are child enrollment and educational achievement, as measured by the numeracy and literacy exams. The principal explanatory variable is the treatment status of the village. We will be also be interested in determining differential effects of the two treatment groups, across boys and girls.

The baseline model used in the analysis is:

$$Y_i = \beta_0 + \beta_1 T_i + \beta_2 X_i + \varepsilon_{ij}, \tag{1}$$

where Y_i is the outcome of interest for child i, T_i is a dummy variable indicating whether child i lives in a village assigned a PPRS school, and X_i is a vector of socio-demographic controls. Standard errors are clustered at the village level, j. In alternative specifications, we disaggregate the two treatments, and include interactions of the treatment with the female dummy.

4.4 Internal Validity

The validity of our results depends upon the comparability of populations across treatment and control groups. Because the villages were randomly selected, treatment should be orthogonal to household and child characteristics that might be correlated with the outcomes of interest. Insofar as this holds, it will be sufficient to compare outcomes across groups to evaluate the effect of the intervention. To assess the comparability of villages, we tabulate household and child characteristics across the treatment and control for the baseline and two follow-up surveys.

Table 2 gives the tabulation for the baseline and two follow-up surveys. Columns (1), (3), and (5) gives the mean values of the indicated variable in control villages, while columns (2), (4), and (6) gives the treatment differential, as identified from a regression of the variable on a pooled treatment dummy. Columns (1)-(2) use the baseline survey, and columns (4)-(8) the two follow-up surveys. The differences across survey groups are quite small: the only apparent imbalance is in the percentage of children who are girls, with each of the three surveys showing a slightly higher percentage of girls than boys in treatment villages (4.1, 3.8, and 2.7 percentage points for the baseline and two follow-up surveys, respectively). In appendix table A1, we provide the same tabulation, showing the balance across the two treatment groups. The differences are again quite small: the only apparent imbalance here is a smaller average household size in the Differentiated-subsidy villages (-0.798 members), though this difference is found only in the first follow-up survey.

In sum, the research design appears to have successfully randomized the sample, so that treatment status is orthogonal to village characteristics that one would be concerned might be correlated with the outcomes of interest.

4.5 Treatment Differential

We first assess the characteristics of the program schools, and compare them to government and private schools. To do this, we make use of the school surveys conducted during the second follow-up survey, in which information was gathered on a variety of school and teacher characteristics, using both visual inspection by enumerators, as well as interviews with headmasters and individual teachers.

Table 3 shows differences according to school type. Columns (1) and (4) provide mean levels of the indicated variables for PPRS schools, with the level of observation being the child-school. Columns (2) and (5) present the PPRS-government school differentials according to the same characteristics, with the differences estimated from a regression of the indicated variable on a dummy for program schools. Columns (3) and (6) repeat the exercise, now giving the differences between PPRS and private schools. PPRS schools are open 0.764 more days per week than government schools, indicating that they are generally open 6 days per week. Program schools are also more likely to use English as the medium of instruction (31.3 percentage points), and less likely to use Sindhi (-37.4 percentage points). The quality of physical infrastructure is also higher in program than government schools, with more having an adequate number of desks (20.3 percentage points), potable drinking water (34.7 percentage points), electricity (12.9 percentage points), and a toilet (34.0 percentage points).

There is also a marked difference in the characteristics of the teachers in program schools. Using the information collected from headmasters, program schools are reported to be staffed with more teachers than government schools (0.939), with a larger number of teachers being female (1.470); and more of these teachers having either less than 5 years of teaching experience (2.505) or 5 to 10 years of teaching experience (0.409), and fewer having more than 10 years of teaching experience (-2.015). These differences are corroborated by interviews with the individual teachers, where a higher percentage are female (25.2 percentage points), and have fewer years of overall teaching experience (-12.2 years) and teaching experience at their current school (-5.4 years). In addition, these teachers are younger (-14.0 years), have less education (-1.0 years), and lower salaries (-11,735 rupees per month). Despite these differences in teacher characteristics, there is little evidence that teachers spend a different number of hours in teaching-related activities, or that allocate their time differently across tasks, save for an additional hour per week administering exams.

However, there is no evidence for differences in school characteristics across the two treatment schemes. Appendix table A2 replicates the comparison from table 3, with columns (1) and (4) giving the mean level of the indicated variable in the gender-neutral subsidy schools, and columns (2) and (5) the differential for gender-differentiated schools. There is no evidence that entrepreneurs in treatment villages featuring the gender-differentiated subsidy have undertaken investments specifically for the purpose of attracting female students. As we will see later, this is consistent with the absence of a differential effect on female enrollment across the two treatments.

In table 4 we examine the characteristics of schools in which children are enrolled across treatment and control groups. In columns (1) and (3) are reported the characteristics of schools attended by children in control villages, and in columns (2) and (4) the treatment-village differential. Treatment-village children are more likely to be educated with English as the medium of instruction (29.7 percentage points), and less likely using Sindhi (-31.2 percentage points). The building in which classes are held have more classrooms (0.996), and are more likely to have potable water (29.8 percentage points) and toilets (43.6 percentage points). As reported by headmasters, there are more teachers (1.527), and more female teachers (1.716); and more teachers having less than 5 years of experience (2.397) and fewer having more than 10 years of experience (-1.065). These differences are verified by teacher interviews: teachers are more likely to be female (36.6 percentage points), are younger (-9.014 years), have fewer years of education (-1.058), fewer years of teaching experience (-7.401), fewer years teaching at their current school (-2.334), and earn a lower salary (-7,451 rupees). There is some evidence that treatment-village teachers allocate their class-time differently: teachers spend more time per week teaching children in small groups (2.097 hours) and dictating notes or writing notes on the board (2.367 hours).

The change in composition of the teaching staff – with children in treatment villages attending schools with teachers who are more likely to female, are younger, have fewer years of teaching experience, and are lower paid – is consistent with the criteria for participation in the program, with entrepreneurs required to enlist two female teachers in order to qualify. It is also consistent with research on the cost advantages enjoyed by private schools in Pakistan, with entrepreneurs being able to keep costs down by hiring less-educated females and paying them a lower salary than in government schools (Andrabi et al., 2007). There is no evidence that this has resulted in a reduction in the character of the education imparted, since teachers allocate their time to the different teaching tasks similarly across treatment and control villages. In addition, the quality of infrastructure is higher in treatment-village schools, consistent with the infrastructure criteria employed during vetting.[24]

[24] During the vetting, criteria were included on infrastructure items such as drinking water, electricity, and toilets. Ultimately, however, the only requirements for qualification were those described in section IIIA above.

5 VI. Results

5.1 Enrollment Outcomes

School enrollment was determined in two ways: first, the adult respondent for the household survey was asked whether the child was enrolled during the just concluded school term; and, second, the attendance of the child was verified using an attendance list compiled through a headcount conducted during the school survey.[25] The self-reported enrollment was ascertained in both follow-up surveys, while the enrollment verification was conducted only in the second follow-up survey. In what follows, we will discuss the results using both enrollment measures; however, because improvements in test scores are consistent with self-reported enrollment, we view this as the correct measure.

Table 5 shows the effects of the introduction of program schools on enrollment during the two follow-up surveys, pooling together the two treatment groups. Columns (1)-(4) have as the outcome variable self-reported enrollment; column (5) the verified enrollment; and column (6) the highest grade attained. Looking at enrollment effects for younger children, shown in panel A, the pooled treatment effect was a 49 percentage points increase in self-reported enrollment during the first follow-up survey. This effect drops to 30 percentage points in the second follow-up survey. The reason for the decline in the latter is a 20 percentage point increase in enrollment in control villages (from 30% in 2010 to 50% in 2011). The increase was due to the re-opening of a number of previously non-operational government schools in the period between the first and second follow-up surveys.[26]

In panel B, we estimate the treatment effects on enrollment of older children. Despite the fact that these children were ineligible for enrollment in program schools, we nonetheless find significant increases in enrollment, with older children in treatment villages 25.5 and 12.2 percentage points more likely to be enrolled in the first and second follow-ups, respectively. Interestingly, there is no evidence that older children in treatment in villages have attained a higher grade level; the reason for this is a combination of the smaller treatment effect on enrollment, as well as the fact that the older children affected by the treatment are enrolling in the lower grade levels offered in the program schools.[27]

[25] The school surveys were conducted first, so that the attendance decision would not be influenced by the presence of enumerators. Using the attendance sheets collected during the school survey, the enumerators verified the child's attendance with the assistance of the respondent.

[26] The government around this time began to re-open non-operational schools, but apparently refrained from doing so in treatment villages. This decision was not due to the intercession of SEF administrators, who were unaware until much later of this discrepancy; but was likely due to the presence of the PPRS schools and their popularity with local communities, coupled with the resource constraints of the provincial government. This finding would indicate some level of support for the program within the Pakistani government, despite the challenge these schools represent to important vested interests.

[27] Because attendance was not taken for these older children, verified enrollment is not included as an outcome variable in panel B of table 5.

5.2 Test Scores

We next estimate the effect of the treatment on test scores on math and Urdu/Sindhi. The scores were standardized by subtracting off the mean for control villages and dividing by the standard deviation.

Table 6 presents the results from a regression of test scores on treatment status. Children in treatment villages show an approximately 0.62 standard deviations improvement in test scores relative to those in control villages; with the inclusion of a full vector of child, household, and district controls, the coefficient increases to 0.67. These effects are similar across the numeracy and literacy exams. In column (5), we estimate the LATE of child enrollment, with enrollment regressed on the treatment dummy in the first stage, and test scores then regressed on fitted-enrollment; the coefficients given, therefore, are for the second-stage predicted enrollment variable. Children enrolled due to the intervention score 2 standard deviations higher on the exams than the mean of control villages. These results indicate that the schools have been highly effective in imparting to children a knowledge of basic math and literacy.

5.3 Treatment and Gender Disaggregations

Table 7 shows the differential effects of the two treatments on a variety of education outcomes. In columns (1) and (2) the outcomes are self-reported enrollment during the two follow-up surveys, in column (3) verified enrollment during the second follow-up, in column (4) the highest grade attained, and in column (5) the child test score. The explanatory variables are a dummy for the pooled treatments, and a dummy for the Gender-Differentiated subsidy treatment. There is no evidence that the latter has a differential effect on any of the educational outcomes.

Table 8 estimates the differential effect of the treatment according to gender on the same enrollment outcomes. There is some evidence that the enrollment effect of the pooled treatment was larger for girls than boys in the first follow-up, with girls seeing a 5.2 percentage points larger increase in enrollment relative to boys, effectively wiping out the pre-existing gender differential. There is no gender differential in the treatment effect on self-reported follow-up-2 enrollment, verified enrollment, or highest grade.

As the Gender-Differentiated subsidy was introduced in order to remedy the educational gender gap found in the Sindh province, we next turn to assessing the impact it had on female enrollment. Table 9 gives the disaggregated treatment effects and their interaction with gender. There is no evidence for a differential across the two treatments; the difference between coefficients is always small, as are the F-stats.

In sum, our results indicate that the introduction of PPRS schools has had a large impact on child enrollment in these villages. The effects are the same across the two treatments, and there are no differentials according to the child's gender. There is no evidence for a differential effect across the two treatments, indicating that the Gender-Differentiated subsidy had no greater effect on female enrollment than the Gender-Uniform subsidy.

5.4 Aspirations

Given the significant improvement in educational outcomes detailed above, it is unsurprising that parents have adjusted their ambitions for the careers and educational accomplishments deemed desirable and viable for their children. The data used here is from two sources: In the household survey, there was a module in which the respondent was asked their preferences for each individual child in terms of ideal marriage age, ideal level of education, and ideal livelihood. In addition, in the child surveys, each child was asked their preferred future job and level of education.

Table 10 gives the results. In column (1) is given the mean for control villages, and in column (2) the treatment-control differential as estimated from a regression of the indicated variable on the pooled-treatment dummy. Columns (3)-(5) give the coefficients from a regression of the indicated variable on dummies for girls, pooled treatment, and the interaction of the two. In column (2), we see that respondents in treatment villages are more likely to desire that their children become doctors (4.7 percentage points) and engineers (2.4 percentage points), and less likely to desire they become farmers (-4.4 percentage points) and housewives (-4.8 pts). The ideal level of education increases by 1.53 years.

According to the professed ambitions of the child, the only change is an increase in the probability that they want to work for government (4.1 percentage points), which comes from a 12.2 percentage points increase for boys. It is interesting to note that, while children in treatment villages do not desire a higher level of education than those in control villages, children in both control and treatment villages desire a significantly higher level of education than is desired by the parental respondent (11.0 years versus 7.3 years in control villages).

Looking at the gender disaggregations, we see that both boys and girls see a similar increase in the professed aspiration that they become doctors and engineers. Girls in treatment villages are less likely than those in control villages to have housewife reported as their desired profession (-14.8), and more likely to have teacher given instead (6.7 percentage points).[28] Girls in control villages are desired to receive slightly less education than boys (-0.835), while boys and girls both see a significant increase in the ideal level of education in treatment villages (1.456 and 1.705 years, respectively).

[28] The only changes in aspiration expressed by the children themselves is that boys in treatment villages are more likely to report a desire to become government workers (12.2 percentage points), which shift in aspirations is not shared by girls.

5.5 Cost-effectiveness analysis

SEF maintained records of all program costs under detailed accounting heads. Figure 1 depicts the distribution of program cost components in fiscal years 2008–09, 2009–10, and 2010–11. The fiscal year runs from July 1 to June 30. In fiscal year 2008–09, the program was launched. However, subsidy payments to phase-1 program schools were only provided in the last quarter of that fiscal year. Consequently, subsidies represented a small percentage of total program costs in fiscal year 2008–09, while fixed costs and other variable costs such as those related to administering the first phase of entry into the program represented large percentages. Costs in fiscal year 2010–11 are until April 2011, when the second follow-up survey was administered, but two months short of the end of the fiscal year.

Over the evaluation period, SEF incrementally scaled up the program in phases, which affected the level and composition of costs. In fiscal year 2009–10, SEF administered a second phase of entry, and 97 schools were added to the program. By the time of the second follow-up survey, SEF had provided eight subsidy payments to phase-1 program schools. As school operators could not charge any fees, subsidy payments represented the sole source of school revenues. Subsidy costs for phase-1 (all) program schools evolved from 30% (30%) of total costs in fiscal year 2008–09 to 67% (72%) in 2009–10 to 48% (73%) in 2010–11.

The scale-up of the program during the evaluation period also affected how cleanly we could assign costs to phase-1 schools. The cost data allow us to distinguish between subsidy costs for phase-1 and phase-2 program schools, but we could not separate out other types of costs in the same way. The cost data for fiscal year 2010–11 includes early expenses for administering a third phase of entry into the program, which we also could not separate out. Given this, for the cost-effectiveness calculation, we simply treat non-subsidy costs as fully assigned to phase-1 program schools. In addition, in July and August 2010, Sindh experienced major flooding, and some schools were damaged or their operations were disrupted. SEF incurred costs helping to rehabilitate schools and restore school operations. The assignment of total non-subsidy costs to phase-1 schools raises costs used in the cost-effectiveness calculation. The natural disaster also raises costs relative to what could be expected in more normal times. These two factors would work to bias downwards the cost-effectiveness of the program.

All program costs are calculated in present value terms in 2011 US$ following the method proposed by Dhaliwal et al. (2013). The last unannounced monitoring activity conducted by SEF before the second follow-up survey was in February 2011. In that activity for phase-1 schools, SEF found 28,827 children enrolled based on school registers, and 18,820 children in attendance based on a head count. Enrollment counts obtained from school registers may not be reliable if, for example, the registers are not updated regularly or schools perceive it is in their interest to inflate their enrollment counts. Assuming a 20% student absence rate in rural, remote Sindh, we estimate enrollment of 23,525 children, which we presume to be more accurate. Although the evaluation period runs over three fiscal years, program schools operated for 1.5 school years over the period. Depending on the year type (fiscal, school) and child (enrolled, attending), the program cost per child per year ranges from a low of US$77 to a high of US$184.

Over the full evaluation period, the estimated mean program impacts on school enrollment and student test scores were approximately 30% and 0.6 standard deviations, respectively. Using the low and high values of cost per child per year, we estimate cost-effectiveness values of 16% to 39% in school enrollment and 0.3 to 0.8 standard deviations, both per US$100 spent. Program cost-effectiveness values associated with student test scores appear to be at the lower end of the range of similarly-estimated cost-effectiveness values for 14 education interventions reported by Evans and Popova (2016), only superior to a conditional cash transfer program in Africa.

Since mean program impacts are measured with imprecision, following Evans and Popova (2016), we also estimate cost-effectiveness values at the lower and upper bounds of the 90% confidence intervals around mean impacts. At the lower bound, we estimate cost-effectiveness values (associated with the alternative cost per child per year values) of 11% to 27% in school enrollment and 0.2 and 0.5 SDs, per US$100 spent. At the upper bound, we estimate cost-effectiveness values of 22% to 52% in school enrollment and 0.5 to 1.1 SDs, per US$100 spent.

While the program had large mean impacts on school enrollment and student test scores, these impacts were accompanied by relatively large expenditures. Both the large impacts and expenditures are arguably due to the type of intervention: introducing new schools. Most of the other interventions with comparable cost-effectiveness analysis—and with superior cost-effectiveness results—were those introduced into (communities with) preexisting schools (Evans and Popova, 2016). SEF has continued to scale up the program, adding more schools and upgrading some primary schools to middle schools (up to grade 8), which has contributed to falling costs per child per year, as operating costs associated with, for example, program administration and teacher training workshops are spread over a large number of schools and students. We however do not know how program impacts have evolved in tandem with the scale up. To end, our program cost-effectiveness results only account for the costs borne by SEF, the implementer, which subsume all expenditures made by program school operators. The results do not, however, include the net costs—including opportunity costs—borne by households in choosing to send their children to program schools.

6 Quality of Program Schools

One of the reasons for the design of the program as a PPP was to take advantage of the quality premium often ascribed to private education, for which evidence has been found in Pakistan. To determine whether this advantage has carried over to the PPRS schools, we next undertake a comparison of test scores across students enrolled in the public, private, and PPRS schools.

Table 11 gives the results of a regression of the indicated test scores on dummies for public and private schools. In column (1) is given the mean score for students attending the PPRS school, in columns (2) and (3) are given the differentials between the indicated school and the PPRS schools, and in column (4) the p-value for a test of the quality of the government and private school coefficients. Students in PPRS schools score 0.113 standard deviations better than those in government schools on their Urdu tests, and 0.185 standard deviations better on the math exam. In contrast, PPRS schools show no quality differential with private schools.

This comparison does not causally identify the quality differential, as there are likely composition effects that would bias the estimates. The most conspicuous potential bias is that, because program schools attract students who would not otherwise have been enrolled, and because these students are from more socioeconomically disadvantaged backgrounds, the estimated differential would be biased downwards. In this case, the productivity of program schools is even greater than revealed by this simple comparison. If, however, better students are leaving government schools and enrolling in PPRS schools in program villages, then this would bias our results upwards. Though the latter possibility cannot be ruled out, we see in appendix table A3 that this thesis is not consistent with the observable characteristics of households. In column (2), we see that children enrolled in government schools are older, more likely to have been enrolled in school at the time of the baseline, have fathers who are more educated and less likely to be farmers, and live in homes made of better building material.

In addition, we see that there is little evidence that the program schools are inducing child sorting in government schools. In column (5), we see that the characteristics of children in government schools more or less are the same across control and treatment villages, with the exception that children in government schools in treatment villages are slightly older on average than those in control villages (and therefore in a slightly higher grade), which is presumably because some share of the younger children who would have otherwise enrolled in the government school absent the treatment select the program school instead, skewing the age distribution slightly upwards.

The greater productivity of program schools can also be seen in the estimation of the school productivity function. To identify the parameters of the school production function, we regress child test scores on a vector of school characteristics, while including controls for relevant household characteristics. The results of this exercise can be seen in tables 13 and A4, and lend support to the findings discussed above. Specifically, several of the characteristics most closely associated with higher test scores -- such as toilets, drinking water, less experienced teachers, and female teachers (for girls) – are precisely those which the PPRS schools possessed to a greater degree than government schools. This holds even when we include dummy variables for the program schools, indicating that the parameters of the school production function are not capturing to some omitted characteristic of the program schools with which they are correlated.

The higher test scores of children enrolled in program schools, despite their coming from socioeconomically disadvantaged households, coupled with the parameters of the education production function, lend strong support for the thesis that privately-operated schools provide a better education than government-run schools. We will next see that the private schools are not just more effective than the government schools, but that they indeed measure quite favorably even against the hypothetical benchmark of the social planner's solution.

7 Structural model

The results presented in the previous section provide evidence that the use of private schools had the desired effect, with program schools generating educational outcomes superior to those in control villages, despite their attracting students from lower socioeconomic backgrounds. We next assess whether the social planer could have improved on the observable private solution, and if so, by how much and by what mechanism. A simple model elucidates why the entrepreneurs may have incentives that are not perfectly aligned with the social planner. Consider the following simple model of an entrepreneur deciding which school characteristics to provide. As the entrepreneurs are paid based on enrollment, let student demand for the school be denoted by $q(x) > 0$, where is x a vector of characteristics and $q'(x) < 0$. The cost of providing those characteristics is given by a positive increasing function, $c(x)$. The social value of those characteristics is given by a positive increasing function, $h(x)$; this function captures both consumer surplus and broader societal benefits from children receiving an education at the school. The first-order condition for the entrepreneur is:

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

while the corresponding first-order condition for the social planner is:

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

The difference between these two FOCs is the inclusion of the marginal social benefit. In our setting, that term is consumer surplus plus the social value of increased test scores. In general, the entrepreneur will fail to provide the socially optimal level of characteristics because it does not capture the complete rents generated by their provision. In contrast, the social planner will provide characteristics if their marginal social benefit exceeds their cost.

Our exercise consists of four steps: first, we estimate a discrete choice model of student demand for schools; it allows us to compute both the expected distribution of student enrollments, which in turn determines entrepreneurial revenues, and consumer surplus under both observed and counterfactual school configurations. Second, we estimate the costs of providing school characteristics using a simple revealed preference argument; it allows us calculate the cost of providing such configurations. Third, we estimate an education production function relating school characteristics to educational outcomes; it allows us to calculate the counterfactual distribution of student educational outcomes. Finally, we tie it all together with a calculation of the social value of school configurations that accounts for surplus accruing to students, entrepreneur profits, and the broader societal value of education.

We begin by estimating the demand for schooling by students in the villages. In turn, this allows us to evaluate how that surplus changes with changes in school characteristics. We model student demand for schools using a standard logit random utility framework. Each student makes a single choice from a set of schools, , where the utility of choice to student is given by:

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

where X_{ij} is a vector of student-school characteristics, β is a vector of marginal utilities, and ϵ_{ij} is an idiosyncratic shock distributed as Type I Extreme Value. We normalize the utility of not going to school to zero.

For the estimation of the demand function, we included a variety of school and student characteristics shown to be important in the literature on education production functions (Todd and Wolpin, 2003). The student characteristics included are gender, age, distance from house to the school, and several interactions between gender and school characteristics. The school characteristics include the presence of an indoor toilet, drinking water, and electricity; as well as teacher characteristics, such as experience, gender, time spent teaching, and frequency of absence from the classroom. We also include interactions of various school characteristics with an indicator variable for female students, as a substantial body of research has shown the importance of school characteristics such as proper sanitation facilities (Adukia, 2017) the presence of female teachers (Andrabi, Das, and Khwaja, 2008), and distance (Burde and Linden, 2013) for female enrollment and achievement.

Demand estimates are provided in Table 12. Most of the coefficients have the expected signs: students are more likely to attend a school if it has drinking water, has lower (or zero) tuition, is closer to their household, has more experienced teachers who spend more time in the classroom teaching, and is not a government school. The coefficients on female interactions with toilet, distance, and the percentage of teachers that are female are both economically and statistically significant. Boys and older students are more likely to attend school, with boys more likely to attend schools having a larger share of male teachers. Combined with the female student-female teacher interactions, our demand estimates show a preference for gender sorting across schools.

These demand parameters capture the students' willingness-to-pay for various school characteristics. To understand the role of the program schools in producing educational outcomes, we regress student test scores on the same school characteristics to estimate a structural education production function. Table 13 shows the results for several specifications.[29] The table presents the OLS coefficient estimates for each of the characteristics of the school. The first two columns present models without school indicators, one model not controlling for district fixed effects, the other column including these fixed effects. The next two columns present the same model, but including a dummy variable for the PPRS schools (with and without districts fixed effects). Finally, the last two columns present the same model, but controlling by an indicator variable of public school (with and without districts fixed effects). The key school characteristics that influence test scores are the presence of a toilet, teachers with less than 5 years of experience, lack of teacher absences, and the percentage of female teachers if the student is female.[30] Interestingly, some characteristics which are highly demanded by students do not have a corresponding effect on test scores, such as the time spent in the classroom teaching.

Next, we use the demand curve to estimate bounds on the cost of providing school characteristics. We focus on those school characteristics that are most relevant to the education production function and 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

[29] We are only including enrolled children in this regression. When we include non-enrolled children, we get similar coefficients.

[30] As seen in table A4, the improvement in test scores for female students with female teachers comes primarily from improvements in their Urdu scores, with improvements in math scores being smaller and statistically insignificant.

for the fact that in areas with competing schools, providing an additional amenity may not be as profitable as in other areas. The results are shown in Table 14.

The first two amenities are running water and the presence of a toilet. Both male and female students demand running water uniformly, while only female students value toilets. This demand is apparent in the costs incurred in providing these amenities, which are both positive, and in their relative magnitude, where running water is more expensive than having toilet.

The last four characteristics change the composition of the teachers at the school. The first estimate reflects the cost of replacing a male teacher with a female teacher. This is an interesting proposition since male students react negatively to the presence of a female teacher, while the opposite is true 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. This in turn implies that female teachers must be less costly than their male counterparts. Institutional details support this finding. Male teachers tend to be civil servants with relatively high salaries and job security (Andrabi, Das, and Khwaja, 2008); while female teachers in private schools earn 33% less in than male teachers in public schools (after controlling for other characteristics). We also find that 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 with the average monthly frequency teacher absences. Finally, increasing the number of teachers with less than five years of experience reduces costs (in comparison to teachers with more than five years of experience), as might be expected.

Putting these pieces together allows us to address a key question: are entrepreneurs providing school characteristics that maximize student outcomes? To answer this question, we first parameterize the social welfare function:

$$W(x) = CV(x) + \pi(x) + \tau g(x),$$

where $CV(x) = \sum_{i=1}^{N} CV_i(x)$ is the sum of the consumer surplus over all children in the village, $\pi(x)$ is the profit earned by the entrepreneur operating the school, and $\tau g(x)$ is the social value of educationational achievement. We assume that the social value of education is related to overall test scores, given by $g(x)$, and a scalar multiplier, τ.

The logit model provides a foundation for computing the consumer welfare generated by the school. Following Samll and Rosen (1981), the compensating variation of choice set under the logit model is:

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

where $\delta_{ij}(x)$ is the deterministic component of utility of student i choosing school j, α is the disutility of school tuition, and γ is Euler's constant. Our estimates above give the cost of each characteristic, x.

The last component of our welfare analysis is the social benefits of education that are not internalized in the demand function. Since we do not know how exactly the social benefits of education, we choose to parameterize the social benefit function as $h(x) = \tau g(x)$, where $g(x)$ is the education production function estimated above. This specification assumes that social benefits of education are only a function of test scores, and captures the marginal (social) utility of increasing test scores. This approach allows us to: first, solve the social planner's solution, as total benefits of providing characteristics can be consistently compared with their costs; second, show how the social planner's solution to providing characteristics changes with τ, a parameter that we do not have measurements of; and, third, compute the relative efficiency of the observed allocation relative to what the social planner would have done.

Entrepreneur profits are defined as the total revenue of student enrollments (each student generates a fixed fee of 3500 rupees per year) minus the cost of providing the program school's characteristics.

We define the social value of education as the product of the child's annual adult income and a social externality multiplier. To estimate the effect of education on income, we invoke Montenegro and Patrinos (2014), who estimated the upper and lower bound wage gains from an additional year of education at 10.8% and 6.8%, respectively. In addition, we note that an additional year of education in Pakistan is associated with a test score improvement of approximately 0.40 standard deviations (Bau and Das, 2017). Combining these two findings, we assume test score improvement of 0.40 standard deviations to be equivalent with an additional year of education, and therefore to yield wage gains of 10.8% and 6.8% at the upper and lower bounds. The wage improvement is calculated as a function of the baseline wage and the labor force participation rate:

$$\triangle wage_{gb} = blwage_g \times (\frac{zscore(test)}{0.40}) \times \%\triangle wage_b \times participationrate_g,$$

where the subscript g indicates the gender of the child, and b the upper and lower bound estimates of wage gains. The baseline wage (*blwage*) for males is 6600 Rupees per month, and for females is 2000 Rupees per month, and the labor force participation rates for the two are 0.8 and 0.36, respectively.[31] In addition, we inflate the term with a multiplier above to account for social externalities.

For each program school in our sample, we solve the following social planner's problem above:

$$\max_x W(x).$$

[31] Data comes from the Pakistan Social and Living Standards Measurement Survey (2010).

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. This is computationally feasible since, by construction, there is only one program school in each village, and our 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: schools receive a fixed among of money, based mainly on the teachers characteristics. In other words, the budgets of public schools are primarily determined by teacher salaries, regardless of number of students served.[32]

The results of the social planner's problem are shown in Table 15. We report the levels and changes in school characteristics across the observed data and the social planner's solution at the village level. We also report the changes in consumer surplus, enrollments, the cost of providing characteristics, educational outcomes, and the social welfare function.

The most important takeaway from Table 15 is that 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. There is substantial variance across villages, from a lower bound of zero percent increase (i.e. the entrepreneur picked the same set of school characteristics that the social planner would have) to an upper bound of a 40 percent increase. The social planner achieves these increases through a variety of changes to program schools. First, 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. The social planner also exclusively employs teachers with post-secondary education (+52 percentage points), with less than five years of experience (+15 percentage points), and imposes that the average teacher is absent less than four days per month (-15 percentage points). The composition of female teachers changes substantially, as well: on average, the social planner employs 68 percent female teachers (+20 percent points). However, there is substantial heterogeneity in this value across villages: in some schools, the social planner assigns 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 consequently test scores, will suffer if the school employs female teachers, while the opposite is true in villages with relatively many girls.

To understand why the social planner chose these characteristics, Table 15 also reports the change in consumer surplus, enrollments, school costs, and test scores. On average, the social planner chooses characteristics that lower costs, in some cases dramatically. This is primarily driven by the employment of

[32]In other words, the money does not follow the students; the money follows the teachers.

female teachers, who are much less expensive than male 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.

One of the key parameters in our social planner solution is the social value of education. This parameter does not come from any empirical or model-based foundation, and therefore we are interested in understanding how robust our results are when we vary this parameter. The last two columns of Table 16 show the outcomes when the social planner puts a weight of zero on educational outcomes. Interestingly, very little changes in terms of the optimal configurations. The only difference is that the social planner has slightly fewer female teachers.

The takeaway from this exercise is that the entrepreneurs in the program schools are generally doing an excellent job at choosing the characteristics of the schools to maximize total surplus, despite only capturing rents through enrollments. The social planner requires all schools to have toilets and running water, and employs less-experienced, better-educated teachers. The social planner also matches the gender composition of school teachers with the relative number of boys and girls at the village level to increase enrollments.

8 Conclusion

The intervention studied here, wherein primary education is provided to marginalized communities through public-private partnerships, with the government paying private entrepreneurs a per-child subsidy to operate primary schools, has proven remarkably effective in increasing self-reported enrollment rates amongst primary-aged children. The presence of a PPRS school is associated with an increase in enrollment of approximately 30 percentage points. We find no statistically significant differential impact of the intervention on girls' enrollment.

The program also delivers remarkable impact on "quality" of education, as evidenced by both test scores and direct observation of school characteristics. Children in treatment villages score 0.67 standard deviations higher on math and language exams than those in control villages, while children induced to enroll because of the treatment score two standard deviations higher. Children in program schools also score better than children in government schools, despite coming from more socio-economically marginalized households. Information on school characteristics gathered by enumerators through direct observation and headmaster and teacher interviews shows program schools to be of similar and sometimes higher quality than government schools.

We used a structural model of student demand for schools along with an educational production function to assess the efficiency of the intervention. While entrepreneurs only capture profits through enrollments, the equilibrium social surplus is within ten percentage points of the social planner. Relative to the entrepreneurs, the social planner adjusts the mix of female teachers to reflect the underlying gender distribution of students, requires the installation of running water and toilets, and hires less-experienced, better-educated teachers. It is remarkable and reassuring that private entrepreneurs have proven so successful in selecting the most essential characteristics for their schools, and hints at the enormous potential for local actors to strike upon appropriate solutions to local challenges when provided adequate support by the government.

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Figure 1: Distribution of program costs over the evaluation period

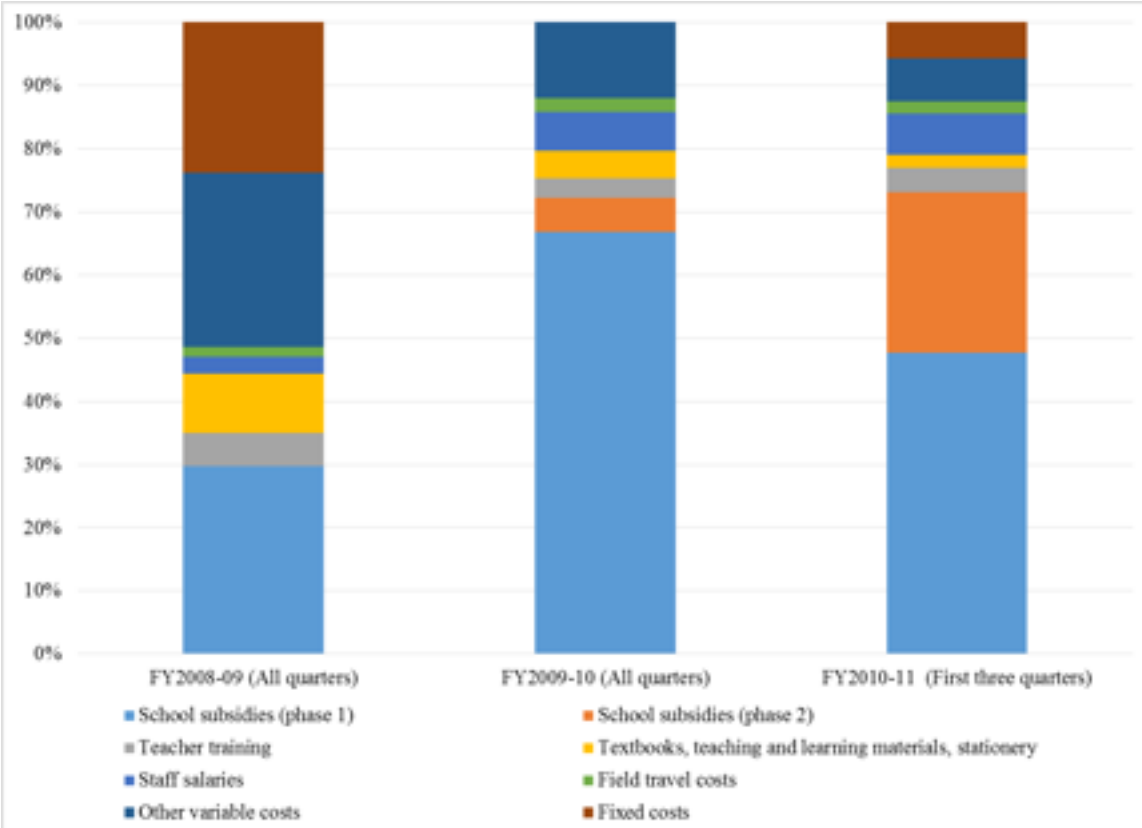

Table 1: Sample Size Coverage

	control	treatment	treat 1	treat 2	total
	(1)	(2)	(3)	(4)	(5)
#villages	38	161	82	79	199
# baseline hhs	445	1644	823	821	2089
# baseline children	1141	4415	2261	2154	5556
# census hhs w/child	1530	7109	3795	3314	8639
# young children	4567	20591	11231	9360	25158
# followup households	1069	4897	2594	2303	5966
# followup young 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.

Table 2: Treatment Balance

	baseline		followup 1		followup 2	
	control	treat - control	control	treat - control	control	treat - control
	(1)	(2)	(3)	(4)	(5)	(6)
child age	6.859	-0.022	7.101	0.078	7.36	0.075
		(0.071)		(0.055)		(0.055)
female	0.379	0.041*	0.414	0.035***	0.424	0.031*
		(0.024)		(0.013)		(0.016)
child in school	0.261	0.008	0.282	-0.025	0.281	-0.026
		(0.046)		(0.081)		(0.085)
child of hh head					0.857	0.022
						(0.026)
household size	9.858	-0.833	9.653	-0.555	7.221	-0.084
		(0.563)		(0.454)		(0.290)
number children	3.018	-0.257	3.954	-0.23	4.756	-0.13
		(0.166)		(0.168)		(0.189)
hh head education	2.571	0.252	1.861	0.508*	2.654	0.107
		(0.398)		(0.300)		(0.315)
hh head farmer	0.613	0.03	0.536	-0.065	0.562	-0.017
		(0.062)		(0.049)		(0.067)
total land			4.942	0.18	4.17	0.972
				(1.254)		(1.092)
pukka house			0.054	0.001	0.057	-0.005
				(0.022)		(0.024)
semi-pukka house			0.188	-0.017	0.192	-0.015
				(0.063)		(0.065)
kaccha house			0.484	0.12	0.511	0.084
				(0.078)		(0.076)
thatched huts			0.274	-0.104	0.24	-0.064
				(0.078)		(0.071)
# goats					3.918	-0.057
						(0.792)
sunni					0.877	0.034
						(0.060)
urdu					0.114	0.045
						(0.043)
sindhi					0.664	0.062
						(0.071)

Note: This table contains average demographic characteristics of children and households from the baseline and the two follow-up surveys. Columns (1), (3), and (5) give the mean for control villages; and columns (2), (4), and (6) the treatment-control differential as determined by a regression of the indicated variable on the treatment dummy. Statistical significance at the one-, five-, and ten-percent levels is indicated by ***, **, and * respectively.

Table 3: School Characteristics by Type

	control	pprs - govt	pprs - private		control	pprs - govt	pprs - private
	(1)	(2)	(3)		(4)	(5)	(6)
school survey long	0.997	0.230***	0.219	#boys	88.755	-1.629	-42.932
		(0.067)	(0.157)			(15.086)	(50.986)
				#girls	71.456	38.983***	-16.387
days operational	5.129	0.953***	0.246			(6.319)	(27.639)
		(0.436)	(0.540)	%female	0.449	0.161***	0.021
open admission	0.88	0.001	0.018			(0.048)	(0.048)
		(0.058)	(0.100)	teacher characteristics			
uniform required	0.024	0.024	-0.312*	days absent	0.836	-0.323	0.248
		(0.017)	(0.181)			(0.460)	(0.266)
tuitition required	0	0	-0.407**	female	0.494	0.342***	-0.038
		(0.000)	(0.170)			(0.076)	(0.175)
sindhi	0.611	-0.365***	0.02	age	25.173	-16.015***	-0.365
		(0.052)	(0.179)			(1.277)	(1.439)
english	0.31	0.310***	-0.023	education	10.963	-1.065***	-0.951***
		(0.045)	(0.177)			(0.161)	(0.276)
				salary	4.065	-12.509***	0.385
# teachers	3.789	0.929***	-2.473			(0.918)	(0.532)
		(0.316)	(1.860)	years teaching	2.788	-13.659***	-0.562
# female teachers	1.993	1.754***	-3.446**			(1.382)	(0.730)
		(0.200)	(1.529)	years teaching same school	1.774	-6.405***	-0.874
# teachers postsecondary	1.901	-0.505	-1.671**			(1.070)	(0.683)
		(0.433)	(0.82)	hours teaching			
# teachers < 5yrs exp	3.137	2.677***	0.661	total	25.194	0.999	-1.309
		(0.183)	(0.714)			(2.616)	(1.231)
# teachers 5-10yrs exp	0.605	0.335**	-2.81	whole class	5.242	-0.445	0.806
		(0.145)	(2.212)			(1.013)	(0.788)
teachers > 10 yrs exp	0.047	-2.140***	-0.323	small group	3.906	0.267	0.179
		(0.303)	(0.366)			(0.404)	(0.674)
				individual	3.744	-0.224	0.086
building	0.968	0.011	-0.032			(0.431)	(0.615)
		(0.037)	(0.020)	notes	3.623	-0.003	0.679
# classrooms	3.234	0.472	0.119			(0.479)	(0.502)
		(0.420)	(0.925)	discipline	2.197	-0.074	-0.712**
sufficient desks	0.805	0.084	0.165			(0.228)	(0.337)
		(0.095)	(0.175)	testing	2.429	0.860***	0.707*
drinking water	0.885	0.337***	-0.115***			(0.422)	(0.375)
		(0.114)	(0.031)	admin	2.031	0.058	0.482*
electricity	0.766	0.063	-0.025			(0.314)	(0.288)
		(0.094)	(0.142)				
toilet	0.85	0.334***	0.196				
		(0.115)	(0.167)				

Note: This table gives the characteristics of program schools, and the program-public and program-private differentials. In columns (1) and (4) are given the mean levels for program villages. The differentials in columns (2)-(3) and (5)-(6) come from a regression of the indicated variable on treatment dummies, estimated individually for private and government schools. The unit of observation is the young childMschool level. Statistical significance at the one-, five-, and ten-percent levels is indicated by ***, **, and * respectively.

Table 4: School Characteristics by Treatment

	control	treatment - control
	(1)	(2)
school survey long	0.95	0.050*
		(0.028)
days operational	5.398	-0.232
		(0.350)
open admission	0.958	-0.072
		(0.045)
uniform required	0	0.021
		(0.014)
tuitition required	0	0
		(0.00)
sindhi	0.931	-0.312***
		0.066
english	0	0.297***
		(0.043)
# teachers	2.278	1.526***
		(0.301)
# female teachers	0.246	1.716***
		(0.240)
# teachers postsecondary	1.533	0.377
		(0.338)
# teachers < 5yrs exp	0.766	2.396***
		(0.269)
# teachers 5-10yrs exp	0.388	0.194
		(0.178)
teachers > 10 yrs exp	1.124	-1.065***
		(0.268)
building	0.919	0.047
		(0.062)
# classrooms	2.192	0.996***
		(0.279)
sufficient desks	0.616	0.186
		(0.139)
drinking water	0.578	0.298*
		(0.153)
electricity	0.628	0.134
		(0.139)
toilet	0.401	0.436***
		(0.148)

	control	treatment - control
	(3)	(4)
#boys	69.919	20.031**
		(9.746)
#girls	45.152	25.801***
		(9.719)
%female	0.389	0.052
		(0.049)
teacher characteristics		
days absent	1.906	-1.009
		(0.850)
female	0.1	0.365***
		(0.085)
age	34.43	-9.004***
		(2.104)
education	12.028	-1.059***
		(0.255)
salary	11.686	-7.449***
		(1.917)
years teaching	8.922	-6.025***
		(1.776)
years teaching same school	3.84	-2.044**
		(0.973)
hours teaching		
total	23.397	1.893
		(5.083)
whole class	6.547	-1.404
		(1.743)
small group	3.174	0.819
		(0.582)
individual	4.16	-0.387
		(0.611)
notes	2.852	0.665
		(0.609)
discipline	2.59	-0.376
		(0.378)
testing	1.513	0.890***
		(0.340)
admin	2.641	-0.597
		(0.655)

Note: This table gives the effect of treatment on the characteristics of the schools in which children are enrolled. Columns (1) and (3) give the control-village mean; columns (2), and (4) give the treatment differential, as estimated from a regression of the indicated variable on a treatment dummy. 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 5: Enrollment

	self-reported enrollment				verified enrollment	highest grade
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: young children						
Followup 1						
pooled treatment	0.498***	0.499***	0.484***	0.487***		
	(0.055)	(0.055)	(0.059)	(0.055)		
N	19294	19294	19294	19294		
R-squared	(0.187)	(0.192)	(0.215)	(0.241)		
Followup 2						
pooled treatment	0.307***	0.307***	0.305***	0.296***	0.296***	0.361***
	(0.060)	(0.060)	(0.059)	(0.060)	(0.041)	(0.116)
N	11571	11571	11571	11571	10215	11443
R-squared	0.08	0.082	0.097	0.105	0.101	0.217
Panel B: older children						
Followup 1						
pooled treatment	0.258***	0.261***	0.246***	0.255***		
	(0.063)	(0.065)	(0.067)	(0.062)		
N	5794	5794	5794	5794		
R-squared	0.04	0.08	0.115	0.146		
Followup 2						
pooled treatment	0.137**	0.141**	0.138***	0.122***		-0.024
	(0.057)	(0.057)	(0.051)	(0.053)		(0.312)
N	5566	5566	5566	5566		5536
R-squared	0.01	0.04	0.074	0.135		0.123
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 tables gives the treatment effects on self-reported enrollment during the census and follow-up, verified enrollment during the follow-up, and the highest grade attained at the time of the time of the 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

	ITT				TOT
	(1)	(2)	(3)	(4)	(5)
math score dev	0.531***	0.521***	0.521***	0.628***	2.038***
	(0.154)	(0.157)	(0.155)	(0.123)	(0.276)
urdu score dev	0.499***	0.490***	0.489***	0.589***	1.8777***
	(0.169)	(0.172)	(0.169)	(0.128)	(0.222)
total socre dev	0.534***	0.525***	0.523***	0.630***	2.025***
	(0.164)	(0.168)	(0.165)	(0.128)	(0.252)
child controls	no	yes	yes	yes	yes
HH controls	no	no	yes	yes	yes
District fixed effects	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.

Table 7: Disaggregated Treatment

	enrollment				
	self-reported		verified	highest	test
	FU 1	FU 2	FU 2	grade	score
	(1)	(2)	(3)	(4)	(5)
treatment	0.443***	0.294***	0.268***	0.348***	0.613***
	(0.061)	(0.061)	(0.045)	(0.120)	(0.132)
treat 2 - treat 1	0.018	0.004	0.058	0.028	0.038
	(0.039)	(0.024)	(0.039)	(0.064)	(0.062)
N	19294	11571	10215	11443	10325
R-squared	0.228	0.105	0.105	0.217	0.203

Note: This table contains estimates of the differential between the two treatment effects. The outcomes are selfM reported enrollment at the time of the census and followup, verified followMup enrollment, the highest grade attained, and the total test score. 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 8: Gender Disaggregations

	enrollment				
	self-reported		verified	highest	test
	FU 1	FU 2	FU 2	grade	score
	(1)	(2)	(3)	(4)	(5)
treatment	0.427***	0.300***	0.293***	0.371***	0.605***
	(0.063)	(0.062)	(0.042)	(0.126)	(0.134)
treatment X female	0.058*	-0.008	0.01	-0.018	0.061
	(0.031)	(0.030)	(0.025)	(0.064)	(0.053)
N	19272	11520	10175	11392	10284
R-squared	0.227	0.105	0.101	0.217	0.202

Note: This table contains estimates of the effect of the program schools by gender. The outcomes are self-reported enrollment at the time of the census and followup, verified followup enrollment, the highest grade attained, and the total test score. 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 9: Disaggregated Treatment

		enrollment				
		self-reported		verified	highest	test
		FU 1	FU 2	FU 2	grade	score
		(1)	(2)	(3)	(4)	(5)
Uniform Stipend		0.465***	0.303***	0.259***	0.387***	0.579***
		(0.059)	(0.063)	(0.047)	(0.132)	(0.137)
Uniform X female		0.05	-0.021	0.022	-0.085	0.08
		(0.030)	(0.033)	(0.029)	(0.079)	(0.054)
Gender Differentiated Stipend		0.465***	0.296***	0.331***	0.353***	0.636***
		(0.061)	(0.064)	(0.045)	(0.131)	(0.138)
Gender Differentiated X female		0.053*	0.005	-0.006	0.055	0.037
		(0.028)	(0.031)	(0.031)	(0.063)	(0.059)
N		19272	11520	10175	11392	10284
R-squared		0.239	0.105	0.104	0.218	0.203
H0: Uniform Subsidy =	F-stat	0.001	0.072	2.93	0.245	0.856
Differentiated Subsidy	p-value	0.977	0.789	0.088	0.621	0.356
H0: Uniform + Uniform*Female =	F-stat	0.015	0.45	0.957	1.926	0.045
Differentiated + Differentiated*Female	p-value	0.903	0.503	0.329	0.167	0.832
H0: Uniform*Female =	F-stat	0.021	1.75	0.703	4.283	1.076
Differentiated * Female	p-value	0.884	0.187	0.403	0.04	0.301

Note: This table contains estimates of the two treatment effects by gender. The outcomes are self-reported enrollment at the time of the census and followup, verified followup enrollment, the highest grade attained, and the total test score. 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 10: Aspirations

	control	treatment - control	female	treatment	treat X female
	(1)	(2)	(3)	(4)	(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	0.258	-1.019**	0.33	-0.147
		(0.439)	(0.413)	(0.456)	(0.448)
civil servant	0.127	0.031	-0.06	0.049	-0.026
		(0.036)	(0.047)	(0.048)	(0.049)
doctor	0.082	0.047***	-0.005	0.058***	-0.024
		(0.018)	(0.022)	(0.019)	(0.025)
private enterprise	0.024	-0.005	-0.019**	-0.009	0.012
		(0.012)	(0.009)	(0.015)	(0.011)
engineer	0.013	0.025***	-0.016**	0.026***	0.006
		(0.007)	(0.007)	(0.009)	(0.010)
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	-0.011	-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	0.008**	-0.005	0.009*	0
		(0.003)	(0.003)	(0.005)	(0.005)
police/army/security	0.098	-0.031	-0.101***	-0.050*	0.042*
		(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	0.026	0.025	-0.012	0.079**
		(0.028)	(0.029)	(0.025)	(0.035)

Note: This table cont ains estimates of the effect of the treatment on th e aspirations for children within the household. Column (1) gives the mean level in control villages, and column (2) the treatment differential. Columns (4)-(6) give the gender differentials across control and treatment villages. 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 11: Test Scores across School Types

	pprs	govt - pprs	priv - pprs	p-value govt=priv	govt treat - control
	(1)	(2)	(3)	(4)	
math score dev	0.717	-0.184***	-0.038	0.532	0.007
		(0.064)	(0.230)		(0.095)
urdu score dev	0.709	-0.111***	-0.028	0.539	0.005
		(0.044)	(0.134)		(0.072)
total socre dev	0.735	-0.159***	-0.038	0.540	0.005
		(0.055)	(0.194)		(0.085)

Note: This table contains estimates of the differences in test scores according to the type of school attended. In column (1) is given the mean test score for children attending program schools (relative to children no enrolled). In column (2) is given the test score differential for children attending government schools; and in column (3) the differential for children attending private school. Column (4) show the p-value from a test of equality between government and private schools. Column (5) shows the differential in test scores enrolled in government schools across treatment and control villages. Test for children scores are demeaned by the control-village village mean, and divided by the standard deviation. Controls are included for child and column column characteristics, including district fixed effects. 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 12: Demand Estimates

demand function	(1)
constant	1.77***
	(0.151)
toilet	0.010
	(0.062)
drinking water	0.459***
	(0.072)
student female	-0.352***
	(0.083)
student age	0.033***
	(0.018)
tuition required	-2.946***
	(0.334)
distance	-0.065
	(0.055)
pct teachers with $<$ 5yrs exp	-0.137***
	(0.010)
pct teachers with $>$ 10yrs exp	0.690***
	(0.126)
pct teachers with post-secondary edu	0.016
	(0.077)
pct teachers female	-0.729***
	(0.082)
pct time teaching	0.465***
	(0.146)
teacher absenteeism	0.057
	(0.071)
female X pct teachers female	0.578***
	(0.010)
female X distance	-0.136***
	(0.081)
female X toilet	0.183***
	(0.075)
govt school	-1.873***
	(0.109)

Table 13: Education Production Function

	total test scores (standardized)					
	(1)	(2)	(3)	(4)	(5)	(6)
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)	(0.99)	(0.105)	(0.099)
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)
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 teachers $<$ 5yrs 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 teachers $>$ 10yrs 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 teachers postsecondary	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 teachers female	0.139	0.017	0.137	0.019	0.138	0.003
	(0.103)	(0.097)	(0.105)	(0.019)	(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)
absenteeism	-0.147*	-0.192**	-0.153*	-0.190**	-0.150*	-0.214**
	(0.086)	(0.096)	(0.085)	(0.099)	(0.085)	(0.097)
pct teachers female X 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)
distance X female	0.005	-0.019	-0.000	-0.018	0.006	-0.013
	(0.017)	(0.017)	(0.018)	(0.017)	(0.019)	(0.015)
toilet X female	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)		
govt 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 coefficients from a regression of (standardized) total test scores against the included school's characteristics. Columns (1), (3), and (5) do not control for district fixed effects; columns (2), (4), and (6) include district fixed effects.

Table 14: Cost Estimates

	(1)
water	3.576***
	(0.218)
toilet	0.763***
	(0.082)
Female Teacher	-4.121***
	(0.529)
Post-Secondary	0.226***
	(0.145)
$<$5 years experience	-1.536***
	(0.294)
absent $>$4 days	0.736***
	(0.130)

Note: This table contains the calculation for the (bounded) costs of the demand and supply model.

Table 15: Social Planner Solution

	Private Observed	Social Planner Solution					
						No Externality	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Toilet	0.82	1.00	0	1	1	1	0
Drinking Water	0.87	1.00	0	1	1	1	0
Pct. Female Teachers	0.48	0.68	0.3	0	1	0.66	0.3
Pct. Teachers with Post-Secondary Education	0.48	1.00	0	1	1	1	0
Pct. Teachers with Less than Five Years Experience	0.85	1.00	0	1	1	1	0
Pct. Teachers Absent Four or More Days per Month	0.15	0.00	0	0	0	0	0
Change test scores		1541	645	208	3046	1541	645
Change in cost		-635	603	-3175	285	-617	603
Change in consumer surplus		9972	4508	1245	20242	10004	4504
Change in enrollment		47.14	20.56	6.26	98.19	47.23	20.56
Change in income (upper bound)		1304107	570427	187528	2503614	1304697	570401
Change in income (lower bound)		821104	359157	118073	1576350	821476	359141
Total surplus (upper bound)	1,345,777	1477147	627335	240016	2809626	1477185	627333
Total surplus (lower bound)	908.068	994144	416418	169630	1882361	993963	416429

Notes: This table presents the social planner's solution and the observed private solution.

Appendix

Table A.1: Balance Across Treatment Groups

	Baseline		Followup 1		Followup 2	
	Uniform Average	Gender-Uniform	Uniform Average	Gender - Uniform	Uniform Average	Gender - Uniform
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Child Characteristics						
child age	6.859	-0.043	8.52	-0.043	9.421	-0.064
		(0.062)		(0.116)		(0.121)
female	0.413	0.014	0.429	0.011	0.436	0.011
		(0.018)		(0.010)		(0.012)
child in school	0.275	-0.013	0.289	-0.023	0.292	0
		(0.042)		(0.059)		(0.062)
child of hh head					0.881	0.02
						(0.021)
Panel B: Household Characteristics						
household size	9.202	-0.364	9.561	-7.96**	7.294	0.107
		(0.438)		(0.374)		(0.229)
number children	2.76	0.001	3.929	-0.216	4.794	-0.002
		(0.133)		(0.135)		(0.140)
hh head education	2.906	-0.169	2.384	-0.001	2.689	0.094
		(0.342)		(0.286)		(0.291)
hh head farmer	0.648	-0.01	0.467	-0.005	0.556	-0.044
		(0.047)		(0.049)		(0.048)
total land			6.171	-2.073	5.655	-1.117
				(1.474)		(1.366)
Household Structure						
pukka house			0.49	0.011	0.046	0.016
				(0.023)		(0.026)
semi-pukka house			0.186	-0.018	0.194	-0.023
				(0.050)		(0.056)
kaccha house			0.6	0.001	0.604	-0.023
				(0.062)		(0.065)
thatched huts			0.165	0.005	0.156	0.03
				(0.065)		(0.068)
# goats					3.878	0.255
						(0.834)
sunni					0.91	-0.012
						(0.047)
Language						
urdu					0.152	-0.004
						(0.046)
sindhi					0.709	0.061
						(0.059)
Panel C: Estimated Bias						
Estimate		0.003		0.002		-0.010
p-value		0.777		0.826		0.195

Notes: This table contains average demographic characteristics of children and households from the baseline and two follow-ups surveys. Columns (1), (3), and (5) give the mean for the Uniform subsidy villages; and columns (2), (4), and (6) the Uniform-Gender Differentiated differential as determined by a regression of the indicated variable on the Uniform treatment dummy, limiting the sample to treatment villages. Statistical significance at the one-, five-, and ten-percent levels is indicated by ***, **, and * respectively.

Table A.2: School Characteristics by Treatment Group

	Uniform Mean (1)	Gender-Uniform (2)		Uniform Mean (4)	Gender-Uniform (5)
school survey long	1	0	#boys	90.594	-3.786
		(0.000)			(9.397)
			#girls	71.019	0.555
days operational	5.088	0.069			(7.567)
		(0.246)	%female	0.445	0.007
open admission	0.904	-0.048			(0.031)
		(0.060)	teacher characteristics		
uniform required	0.047	-0.047	days absent	0.864	-0.053
		(0.033)			(0.222)
tuitition required	0	0	female	0.499	-0.014
		(0.000)			(0.087)
sindhi	0.669	-0.116	age	25.249	-0.154
		(0.096)			(0.838)
english	0.257	0.108	education	11.051	-0.171
		(0.090)			(0.160)
			salary	4.031	0.073
# teachers	3.654	0.261			(0.223)
		(0.324)	years teaching	2.608	0.362
# female teachers	2.05	-0.132			(0.247)
		(0.344)	years teaching same school	1.828	-0.112
# teachers postsecondary	1.954	-0.115			(0.175)
		(0.461)	hours teaching		
# teachers $<$ 5yrs exp	2.963	0.345	total	25.612	-0.895
		(0.290)			(1.504)
# teachers 5-10yrs exp	0.648	-0.091	whole class	5.543	-0.648
		(0.185)			(0.620)
teachers $>$ 10 yrs exp	0.043	0.008	small group	4.010	-0.175
		(0.036)			(0.465)
			individual	4.070	-0.705
building	0.993	-0.057			(0.548)
		(0.040)	notes	3.879	-0.547
# classrooms	3.167	0.127			(0.459)
		(0.286)	discipline	2.102	0.190
sufficient desks	0.854	-0.099			(0.230)
		(0.085)	testing	2.138	0.603
drinking water	0.876	0.021			(0.495)
		(0.062)	admin	1.795	0.487
electricity	0.790	-0.046			(0.367)
		(0.085)			
toilet	0.835	0.029			
		(0.068)			

Note: This table gives the characteristics of Uniform-subsidy program schools, and the Uniform-Gender Differentiated differentials. In columns (1) and (3) are given the mean levels for Uniform-subsidy schools. The differentials in columns (2) and (4) come from a regression of the indicated variable on Gender-Differentiateddummies, including only treatment villages. The unit of observation is the young child-school. Statistical significance at the one-, five-, and ten-percent levels is indicated by ***, **, and * respectively.

Table A.3: Test Scores by School Type

	pprs (1)	govt - pprs	priv - pprs (3)	p-value govt=priv (4)	govt treat - control (6)
child age	7.427	0.126	0.086	0.779	0.294**
		(0.078)	(0.118)		(0.116)
female	0.459	-0.024	-0.049	0.616	0.021
		(0.024)	(0.043)		(0.049)
baseline child in school	0.252	0.085	0.128	0.746	0.199**
		(0.064)	(0.126)		(0.087)
current grade	1.402	0.508***	-0.281	0.032	0.340**
		(0.066)	(0.361)		(0.132)
age first enrolled	5.520	-0.232***	0.625**	0.001	0.108
		(0.062)	(0.259)		(0.096)
child of hh head	0.882	-0.032	-0.012	0.752	0.021
		(0.021)	(0.061)		(0.047)
household size	7.024	2.03	-0.662*	0.049	-0.545
		(0.245)	(0.400)		(0.484)
number children	4.578	0.120	-0.282	0.234	-0.451
		(0.169)	(0.311)		(0.283)
hh head education	2.762	0.803***	0.595	0.790	0.435
		(0.284)	(0.762)		(0.340)
hh head farmer	0.560	-0.107**	0.138	0.016	-0.009
		(0.042)	(0.099)		(0.076)
total land	5.398	-1.741	1.337	0.171	-2.679
		(1.295)	(2.180)		(1.938)
Household Structure					
pukka house	0.053	-0.015	0.076	0.125	0.017
		(0.019)	(0.058)		(0.028)
semi-pukka house	0.162	0.146***	-0.022	0.011	-0.012
		(0.049)	(0.059)		(0.129)
kaccha house	0.624	-0.112**	-0.009	0.311	-0.017
		(0.053)	(0.095)		(0.086)
thatched huts	0.162	-0.019	-0.045	0.637	0.012
		(0.038)	(0.046)		(0.106)
# goats	3.778	-0.081	0.128	0.743	-0.978
		(0.439)	(0.524)		(0.819)
sunni	0.914	-0.061	0.082	0.028	0.092
		(0.057)	(0.050)		(0.129)
Language					
urdu	0.165	-0.013	0.020	0.782	-0.039
		(0.037)	(0.120)		(0.070)
sindhi	0.720	-0.014	-0.034	0.880	0.166*
		(0.047)	(0.135)		(0.098)

Notes: This table presents comparisons of child characteristics according to the type of school in which the child enrolled. Column (1) gives the mean for children enrolled in program schools. Column (2) and (3) give the government and private school differentials, which comes from a regression of the indicated variable on dummies for the two school types in which children are enrolled. Column (4) gives the p-value from a test of equality for the government and private school coefficients. Column (5) gives the differential for children enrolled in government schools across treatment and control villages.

Table A.4: Education Production Function

	Urdu Score				Math Score			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
toilet	0.241***	0.163**	0.283***	0.152*	0.217***	0.133	0.258**	0.105
	(0.079)	(0.067)	(0.088)	(0.079)	(0.103)	(0.095)	(0.114)	(0.100)
drinking water	0.055	0.082	0.043	0.082	0.223*	0.220*	0.227*	0.232*
	(0.81)	(0.82)	(0.84)	(0.68)	(0.124)	(0.122)	(0.127)	(0.121)
female	-0.048	-0.030	-0.043	-0.028	-0.072	-0.051	-0.049	-0.034
	(0.039)	(0.037)	(0.040)	(0.038)	(0.058)	(0.061)	(0.061)	(0.063)
age	0.087***	0.086***	0.086***	0.085***	0.102***	0.099***	0.101***	0.099***
	(0.011)	(0.011)	(0.012)	(0.011)	(0.013)	(0.012)	(0.013)	(0.012)
tuition required	0.048	0.022	-0.045	0.056	0.055	-0.017	-0.022	0.084
	(0.131)	(0.083)	(0.181)	(0.137)	(0.125)	(0.143)	(0.172)	(0.211)
distance	-0.007	-0.007	-0.007	-0.007	-0.012	-0.016	-0.009	-0.015
	(0.038)	(0.031)	(0.038)	(0.031)	(0.045)	(0.032)	(0.044)	(0.030)
pct teachers $<$ 5yrs exp	0.155	0.188	0.181	0.183	0.429**	0.471***	0.439**	0.438**
	(0.148)	(0.155)	(0.150)	(0.153)	(0.170)	(0.179)	(0.170)	(0.175)
pct teachers $>$ 10yrs exp	0.209	0.174	0.123	0.212	0.395*	0.427**	0.323	0.489*
	(0.146)	(0.163)	(0.222)	(0.228)	(0.203)	(0.209)	(0.271)	(0.271)
pct teachers postsecondary	0.205**	0.073	0.201*	0.077	0.143	-0.028	0.132	-0.039
	(0.099)	(0.088)	(0.103)	(0.093)	(0.129)	(0.112)	(0.136)	(0.119)
pct teachers female	0.118	-0.012	0.115	-0.010	0.138	0.028	0.137	0.029
	(0.091)	(0.086)	(0.093)	(0.086)	(0.109)	(0.104)	(0.112)	(0.104)
pct time teaching	-0.309	-0.026	-0.275	-0.025	-0.112	0.149	-0.029	0.214
	(0.279)	(0.298)	(0.307)	(0.345)	(0.345)	(0.394)	(0.369)	(0.443)
absenteeism	-0.127	-0.154*	-0.139*	-0.157*	-0.140	-0.202**	-0.139	-0.195**
	(0.082)	(0.082)	(0.081)	(0.084)	(0.086)	(0.094)	(0.086)	(0.097)
pct teachers female X female	0.095*	0.117**	0.098*	0.115**	0.049	0.075	0.046	0.066
	(0.056)	(0.055)	(0.057)	(0.055)	(0.067)	(0.065)	(0.067)	(0.064)
distance X female	0.001	-0.023	-0.004	-0.022	0.008	-0.016	0.003	-0.015
	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)
toilet X female	0.001	-0.025	-0.003	-0.028	0.026	-0.010	0.008	-0.024
	(0.053)	(0.050)	(0.055)	(0.051)	(0.075)	(0.073)	(0.078)	(0.074)
PPRS school			-0.121	0.045			-0.095	0.103
			(0.139)	(0.144)			(0.171)	(0.180)
R-squared	0.110	0.178	0.112	0.178	0.113	0.183	0.112	0.184
N	5478	5478	5429	5429	5446	5446	5397	5397
district fixed effects	no	yes	no	yes	no	yes	no	yes

Note: This table presents the coefficients from a regression of (standardized) Urdu and math test scores against the included school's characteristics. Columns (1), (3), (5), and (7) do not control for district fixed effects; columns (2), (4), (6), and (8) include district fixed effects.