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Evaluating the Impact of Public Student Subsidies on Low-Cost Private Schools in Pakistan

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ABSTRACT *This paper examines the impacts of accountability-based public per-student subsidies provided to low-cost private schools in Punjab, Pakistan on student enrolment and school inputs. Programme entry is contingent on achieving a minimum pass rate on a specially-designed academic test. We use regression discontinuity to estimate impacts on schools that joined the programme in the last entry round (phase 4) before follow-up survey data collection. We find large positive impacts on school enrolment, number of teachers, and other inputs for programme schools near the minimum pass rate.*

1. Introduction

In 2012/2013, estimated net enrolment rates in Pakistan were 68 per cent at the primary school level, 38 per cent at the middle school level, and 26 per cent at the high school level (2012/2013 Pakistan Social and Living Standards Measurement [PSLM] survey report, Pakistan Bureau of Statistics).[1] These levels are low in absolute terms, relative to other countries in the South Asia region, and relative to other developing countries at Pakistan's per capita income level. Given the trend to date, the United Nations Educational, Scientific and Cultural Organization (UNESCO) reports that Pakistan is unlikely to meet the United Nations' Millennium Development Goal of universal primary education by 2015 (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2014). Initiatives that produce significant, sustained gains in school participation are therefore critical.

The public school system is the predominant provider of education in Pakistan, including in Punjab province, the site of our evaluation. In 2012/2013, 61 per cent of primary school students in the province were in public schools (2012/2013 PSLM survey report, Pakistan Bureau of Statistics). Qualitative and quantitative evidence suggests that the public school system has been hampered in its ability to effectively and efficiently increase and improve schooling inputs – leave alone increase school quality and, in turn, education outcomes – mainly due to poor system governance and accountability (see, for example, Social Policy and Development Centre, 2003).

Against this backdrop, the Punjab government has begun contracting the sizable and growing low-cost private school system in the province to deliver schooling with a minimum level of quality to poor households. Importantly, under these public-private partnership (PPP) initiatives, the government expects to hold private schools accountable for meeting contract terms.[2] The question that remains is whether the government succeeds in doing this, when it has largely failed to hold itself accountable

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for its own basic service delivery performance. Indeed, the effectiveness and efficiency of public budgetary allocations towards PPP initiatives in education depends on the answer to this question.

In this paper, we evaluate the causal effects of an accountability-based public subsidy programme to low-cost private schools in the province of Punjab, Pakistan on school enrolment and inputs. Administered by the Punjab Education Foundation (PEF), the Foundation Assisted Schools (FAS) programme leverages the low-cost private school system in the province in an attempt to increase equitable access to schooling. The programme offers a monthly per-student cash subsidy. To participate in the programme, schools must offer free schooling to all enrolled children and achieve a minimum pass rate on a standardised academic test administered by PEF semi-annually. Unlike standard subsidy programmes that directly finance school inputs (Gauri & Vawda, 2003), programme schools are free to decide how to spend the subsidy.

The FAS programme was initiated in November 2005 and expanded in phases. At the time of our follow-up field survey data collection in May 2009, the programme had completed four phases of expansion, and covered 474,000 students in 1,082 low-cost private schools at the primary, middle, and secondary school levels in 18 of Punjab's 35 districts.[3] In districts with the highest concentration of programme schools, the programme covered approximately one-fifth of all recorded private schools.

To the best of our knowledge, credible evidence on the impacts of public subsidies to private schools is limited. The study by Kim, Alderman, and Orazem (1999) is particularly pertinent as they evaluate a public subsidy programme in Pakistan, which shares some of the design elements of the FAS programme. Using a difference-in-differences approach, Kim et al. (1999) evaluated a public subsidy programme in a randomly-selected subset of poor urban neighbourhoods in Balochistan province. They found that the programme substantially increased both girls' and boys' school participation and that these increases were obtained at a lower cost than would be possible through the public school system. The few well-identified evaluation studies of the impacts of publicly-supported private schools contrast sharply with the rising use of such initiatives around the world (World Bank, 2009).

Our study seeks answers to two questions. First, what is the causal effect of the FAS programme on the number of students in programme schools? Second, what is the causal effect of the programme on inputs, namely the number of teachers, classrooms, and toilets, as well as student-teacher and student-classroom ratios in programme schools? To answer these questions, we take advantage of the treatment assignment process for schools. Schools were either treated (a programme school) or untreated (a rejected school) on the basis of their test pass rates relative to a cut-off. This assignment process allows us to use sharp regression discontinuity (RD) to identify the causal effect of the programme. We validate the RD design using administrative data from the programme application process. We estimate impacts on schools that entered the programme in phase 4, the last entry round before our follow-up data collection, and were close to the test pass rate cut-off. Follow-up data were obtained from a field survey administered 17 months after phase-4 schools entered the programme.

We find robust evidence of positive impacts on the number of students, teachers, and classrooms and negative impacts on student-classroom ratios for phase-4 programme schools close to the pass rate cut-off. Programme impacts were sizable both in absolute terms and relative to baseline means. Our conservative estimates indicate that, within 17 months, the programme expanded schools by, on average, 137 students (+59%), 4 teachers (+46%), and 4 classrooms (+47%) and reduced student-classroom ratios by, on average, 4 students per classroom (–14%). Our cost-effectiveness analysis indicates that the FAS programme is among the cheapest interventions in developing countries for generating enrolment gains.

The estimated impact on enrolment must be interpreted cautiously given that we are unable to establish the extent to which the documented enrolment gains translate into school participation gains. If schools that join the programme become more attractive vis-à-vis other schooling options, the programme is likely to induce both displacement and diversion effects: some share of the new enrolment in the programme school will likely come from students already enrolled in other schools or children that where initially considering enrolling elsewhere.

We are also unable to establish the aggregate household welfare effects of the programme. The fact that enrolment has increased in programme schools suggests that households have re-optimised their schooling decision in favour of programme schools. Holding everything constant, we predict that the elimination of school fees in programme schools raises aggregate household welfare. Information on student academic achievement (given a short evaluation window), school attainment, outcomes in labour and other markets, and outcomes related to quality of life (given a longer evaluation window) would be useful for ascertaining aggregate welfare effects across multiple, pertinent dimensions.

The remainder of the paper is organised as follows. Section 2 describes the education context at the time the FAS programme was introduced. Section 3 describes the programme. Section 4 presents our identification and estimation strategy. Section 5 describes the data and presents summary statistics. Section 6 presents our impact and cost-effectiveness estimates. Section 7 summarises and interprets our main findings and discusses potential threats to internal validity, external validity, and welfare implications.

2. Context

The FAS programme was conceived and introduced into an education landscape characterised by three major features: first, poor and inequitable school participation; second, a weak public school system, which remains the dominant service provider; and third, a rapidly growing private school system with the potential to address poor and inequitable school participation.

The education situation of Punjab – Pakistan's most prosperous and populous province and the site of the FAS programme – is by and large comparable to the rest of the country. At the time the FAS programme was initiated, the estimated school participation rate for children ages 6–15 was 65.7 per cent in the province.[4]

The public school system has been hampered in its ability to improve education outcomes due to, in large part, the lack of effective accountability and incentive systems, which promote the legitimate and efficient use of allocated resources (Government of Pakistan, 2009; Social Policy and Development Center, 2003). While the public school system has struggled to enrol and educate children, the private school system has grown in both numbers and share of enrolment. In addition, responding to the broad demand for greater access and better quality, the system has evolved in character, becoming more egalitarian, less elitist, and increasingly reaching low-income and rural households.[5] Using private school census data from 2000, Andrabi, Das and Khwaja (2008) found an exponential increase in the number of private schools in the 1990s, with more than one-half of current private schools established after 1995. Furthermore, they found that schools established before 1990 came up predominantly in urban areas, but, subsequently, schools have increasingly come up in rural areas.

The increase in the share of enrolment in private schools parallels the growth in the number of private schools. In 2004/2005, 15.8 per cent of children ages 6–15 were enrolled in private schools in Pakistan; in Punjab, 18.5 per cent of the corresponding population was enrolled in private schools. These percentages represent cumulative increases of 40.7 per cent and 37.4 per cent, respectively, since 1998/1999. Andrabi et al. (2008) found that the growth rate in private school enrolment over the 1990s was highest among low-income households nationally, and among middle-income households in rural areas. In contrast, public school enrolment declined in both urban and rural areas and across the household income distribution over the same period.

Andrabi, Das, & Khwaja (2008) also found that fees for private schools were generally low and constituted a small percentage of mean annual household expenditure. In 2000, median annual fees per student in all of Pakistan were 960 rupees (US$23.4) in urban areas and 751 rupees (US$18.3) in rural areas.[6] The corresponding statistics for Punjab were lower, at 828 rupees (US$20.2) and 600 rupees (US$14.6), respectively. These private schools are affordable due to their low operating costs. One main cost component is labour: teachers. Private schools tend to be staffed by young, unmarried women with low levels of education and little or no formal training in teaching. Average pay for private school teachers is also paid substantially less than for public school teachers, even after accounting for differences in the characteristics of teachers between the two school types (Andrabi, Das, Khwaja, Vishwanath, & Zajonc, 2008).

Finally, there is growing evidence that private schooling is associated with higher student academic achievement in Pakistan (Alderman, Orazem, & Paterno, 2001; Andrabi, Bau, Das, & Khwaja, 2010;

Andrabi, Das, Khwaja, & Zajonc, 2011; Aslam, 2003, 2009). Among these studies, Andrabi et al. (2010) identify the causal effect of private schooling on student academic achievement for primary-grade students in selected villages in Punjab through an instrumental variables strategy. They find that average student academic achievement in private schools is 0.8–1.0 standard deviations higher than in public schools.

3. The Foundation-Assisted Schools Programme[7]

3.1. Programme Description

The FAS programme is administered by PEF, a publicly-funded, semi-autonomous statutory organization established in 1991. PEF serves as the main institutional mechanism for education PPPs in Punjab. The organization's primary aims are to enable poor households to access private education with a minimum level of quality. PEF spent 1.1 billion rupees (US$12.9 million) on benefits under the FAS programme.[8] This amount accounted for 61 per cent of total expenditures by PEF in fiscal year 2007/2008. As of September 2008, the programme had completed four entry phases, and covered 1,082 private primary, middle, and secondary schools in 18 out of Punjab's 36 districts. Of these, 945 programme schools (87%) were located in just seven districts. This number of programme schools represents a sizeable percentage of all private schools in these seven districts: using the 2005 National Education Census, a census of schools in Pakistan, we estimate that the programme covered 21 per cent of private schools in these districts.

The programme was initially designed to target districts that ranked lowest in adult literacy rates based on data from the 2003/2004 Multiple Indicators Cluster Survey (Government of Punjab 2004). In phases 1 and 2, however, this targeting strategy was not applied due to limited institutional and logistical capacity in PEF (Malik, 2007). In phases 3 and 4, the targeting strategy was effectively applied. Consequently, 51 per cent of programme schools were located in districts ranked in the bottom-quarter, and 89 per cent were located in those districts ranked in the bottom-half of literacy rankings.

Table 1 presents the distribution of programme schools by selected characteristics measured in September 2008. Looking at all four phases together (Column 5), the mean school size was 351

Table 1. Mean characteristics of FAS programme schools

Characteristic	Phase 1 (1)	Phase 2 (2)	Phase 3 (3)	Phase 4 (4)	All phases (5)
Students	561.40	547.42	373.83	241.66	351.18
Level					
Primary	0.02	0.05	0.05	0.11	0.07
Middle	0.24	0.31	0.60	0.69	0.59
Secondary	0.73	0.65	0.35	0.20	0.34
Gender type					
Coeducational	0.69	0.86	0.83	0.82	0.83
Girls-only	0.20	0.11	0.09	0.11	0.11
Boys-only	0.11	0.03	0.07	0.07	0.07
Registration status					
Registered	0.91	0.97	0.89	0.81	0.87
Unregistered	0.09	0.03	0.11	0.19	0.13
Location					
Urban	0.36	0.45	0.48	0.42	0.45
Rural	0.64	0.55	0.52	0.58	0.55
N	45	133	480	424	1,082

Notes: Statistics exclude the three higher secondary schools that are programme schools. Statistics are constructed from administrative data from September 2008.

students, 59 per cent of schools were middle level, 83 per cent were coeducational, 87 per cent were registered with local government authorities, and 55 per cent were rural. The distribution of programme schools in each phase (Columns 1 to 4) was roughly comparable, with the exception of the school's level. Phase-1 and phase-2 programme schools were mainly secondary schools (65% and 73%), whereas phase-3 and phase-4 programme schools were mainly middle schools (60% and 69%). School size appears to be decreasing with each phase: the mean size of phase-1 programme schools was 561 students, whereas that of phase-4 programme schools was 242 students. There may be many explanations for this pattern, among which is the length of exposure to the programme.

3.2. Programme Benefits and Eligibility

The main programme benefit is an enrolment-related subsidy. The programme school receives a monthly per-student cash subsidy of 300 rupees (US$3.5) up to a maximum of 750 students.[9] Given a mean school size of 215 students at the time of application to the programme, the mean monthly subsidy payment to a programme school was roughly 64,500 rupees (US$759) at programme entry. Enrolment information for determining the size of the subsidy was submitted by programme schools to PEF on a monthly basis using standardised reporting forms. If enrolment increased by 50 students or more over one month, PEF visited the school to verify the information before raising the subsidy. PEF indicated that large changes in enrolment mostly occurred in April, at the start of the school year.

PEF reports that the subsidy level was set low for two reasons. First, it confines the attractiveness of the programme to low-cost private schools. Second, it raises the political palatability of the programme, as the per-student subsidy amount is less than half of the estimated per-student expenditure in the public school system at the time the programme was introduced.[10] The subsidy benefit is paid for all 12 months of the year. To facilitate timely and regular payments, starting in August 2007, the benefit amounts have been transferred electronically to the bank accounts of programme schools.

Entry into the programme followed a three-step process. In step one, PEF issued a call for applications in newspapers. Eligibility was restricted to existing private primary, middle, and secondary schools with a minimum enrolment of 100 students from the districts listed in the call. With few exceptions, only schools that submitted properly completed applications by the announced deadline were considered for the next step. In step two, PEF inspection teams visited schools to further screen them, a largely subjective exercise. In step three – introduced starting with phase 3 – schools were required to take a test. All students in selected grades who were present in school on the day of the inspection were given a standardised academic test called the Short Listing Quality Assurance Test (SLQAT), a pared-down version of the Quality Assurance Test (QAT) used to determine continuing benefit eligibility once schools enter the programme.[11] The SLQAT is 55-minute, written, curriculum-based test. It tests knowledge and comprehension in three subjects: English, Urdu, and mathematics. The grades to be tested were randomly selected by PEF and were not disclosed in advance. The school qualified for the programme if at least 67 per cent of tested students score 33 per cent or higher on the SLQAT.

According to PEF records, of the 1,430 schools that submitted properly filled-in applications and were inspected in phase 4, 872 (61%) were offered the SLQAT. Of these schools, 431 (49%) achieved the minimum pass rate and qualified for the programme.[12] And of these schools, 425 (98%) signed the programme participation agreement.

Continuing benefit eligibility conditions and incentives: The programme participation agreement stipulated multiple conditions for continuing benefit eligibility. Three conditions were stringently applied by PEF: the programme school must (1) offer schooling without charge to its students; (2) place and maintain a PEF-issued signboard outside the school gate which notes, among other things, that the school offers free schooling and the contact information for PEF for parents and the public to obtain additional information or register complaints; and (3) participate

Table 2. FAS programme participation status, by phase

Phase	Entrants (1)	Disqualified, all reasons (2)	Disqualified, double QAT failure (3)	Current participation (4)
1	54	9	7	45
2	150	16	13	133
3	482	2	0	480
4	425	1	0	424
Total	1,111	28	20	1,082

Notes: Disqualification also includes voluntary exits. Statistics reflect programme school participation status at the time of the follow-up data collection in May 2009.

in the QAT and at least 67 per cent of the tested students must score 40 per cent or higher on the test.[13, 14]

Only a handful of programme schools were disqualified for any reason, and only 28 out of the 1,111 programme schools (2.5%) exited the programme (Table 2). In addition, most disqualifications were due to two consecutive failures to achieve the minimum pass rate on the QAT. Importantly, for our study, only one phase-4 programme school exited the programme for any reason.[15] Thus, programme dropout was not an issue for phase-4 programme schools.

The structure of the programme (both the benefits and benefit maintenance conditions) can be expected to have a positive effect on education outcomes via multiple channels. First, setting the monthly subsidy in direct proportion to the number of children enrolled creates an incentive to draw in additional students. Second, conditioning the receipt of programme benefits on the elimination of school fees – which lowers the costs of programme schools in relation to competing private schools and matches public schools – is likely to raise the attractiveness of programme schools, particularly for households for which school fees are a major constraint to sending children to private school. Third, public communication through the signboard placed outside the school gate is likely to raise public confidence in the programme and, hence, the attractiveness of programme schools.

Fourth, the programme's structure can directly affect investments in the quantity and quality of school inputs and resources. For example, increases in enrolment induced by the per-student subsidy must be met by increased numbers of classrooms and teachers in order to comply with stipulated maximum student-teacher and student-classroom ratios. The mandated ratios require programme schools that are out-of-compliance to build additional classrooms and hire additional teachers. Physical infrastructure and learning environment conditions require programme schools to conform to proper design and construction when they expand, and that they invest in teaching tools (for example, blackboards) and basic facilities (for example, toilets) as enrolment grows. These input-related conditions encourage schools to schedule investments and resources to either anticipate or accompany increases in enrolment. However, given that these conditions are not stringently applied, investments in school inputs and resources may lag behind enrolment increases, although, reportedly, lag-time was short.

4. Empirical Strategy

Given that phase 4 was the last entry phase at the time we conducted the evaluation, schools that took the phase-4 SLQAT were either treated (a programme school) or untreated (a rejected school) on the basis of their SLQAT pass rate relative to the cut-off (that is, the probability of treatment jumps from 0 to 1 at the cut-off). This structure allowed us to apply a sharp regression discontinuity (RD) design.[16] Under some mild regularity conditions, we identify the average causal effect of the treatment on the treated at the cut-off. We estimate the effect non-parametrically using local linear regression.

4.1 Identification

Following the exposition in Imbens (2004), Van Der Klaauw (2008) and Todd (2007), let y_i denote the outcome of interest (for example, enrolment) in school i, and let the indicator variable $d_i \in \{0, 1\}$ denote treatment assignment, where 1 denotes that the school is covered by the FAS programme (treated), and 0 if not (untreated). In addition, let y_{0i} and y_{1i} denote the potential outcomes of school i in the untreated and treated states, respectively. The actual outcome observed for school i is given by

$$y_i = d_i y_{1i} + (1 - d_i) y_{0i} = y_{0i} + [y_{1i} - y_{0i}] d_i = y_{0i} + \alpha_i d_i \tag{1}$$

where α_i denotes the treatment effect for school i.

To estimate causal effects we use an institutional feature of the programme: eligibility is ultimately determined by the student pass rate obtained by the school on the SLQAT relative to the known pass rate cut-off of 67 per cent. Given that virtually all schools that become eligible to participate in the programme also chose to participate in the programme, in practice, the cut-off determines programme participation. Thus, programme participation status is assigned based on the decision rule

$$d_i(z_i) = 1\{z_i \geq c\} \tag{2}$$

where Z_i denotes school i's pass rate which is perfectly observed (z is more generally referred to as the assignment variable), c the known distinct cut-off pass rate, and $1\{\cdot\}$ an indicator function.

Under the assumptions that (1) the limit $\lim_{e \downarrow 0} E[y_{0i} \mid z_i = c + e]$ (where $e_i > 0$ denotes an arbitrarily-small number) is well defined; (2) $E[y_{0i} \mid z_i = c]$ is continuous in the assignment variable z at the cut-off (that is, the conditional expectations of the outcome variable exhibits local smoothness at the cut-off in the absence of the treatment); and (3) the density of the assignment variable z is positive in the neighbourhood of the cut-off, the difference in the mean outcomes between marginal passers and marginal failers,

$$E[\alpha_i \mid z_i = c] = \lim_{e \downarrow 0} E(y_{1i} \mid z_i = c + e) - \lim_{e \downarrow 0} E(y_{0i} \mid z_i = c - e). \tag{3}$$

identifies the average treatment effect on the treated at the cut-off (Hahn, Todd, & Van Der Klaauw, 2001; Todd, 2007). A sharp RD design neatly fits the phase-4 SLQAT taker data, as the school's pass (eligibility) versus fail (ineligibility) status remains fixed given that phase 4 was the last entry phase before the follow-up data collection.

4.2 Estimation

Given that we are interested in estimating treatment effects at a single point using observations in its neighbourhood, one suitable approach is local smoothing using nonparametric regression. Following Hahn et al. (2001), we opt for local linear regression (a local polynomial of order one). Local linear estimation for a sharp RD design entails individually estimating the conditional expectations of the outcome y at the cut-off from below and above the cut-off, and then subtracting the two estimates. Standard errors, clustered at the district level, are derived following the robust procedure proposed by Calonico, Cattaneo, and Titiunik (2014).

4.3 Choice of Kernel and Bandwidth

Implementing local linear estimation requires specifying the kernel k, the weighting function, and bandwidth $h > 0$, the window width in which the kernel function is applied. We opt for the triangular kernel given that it is boundary optimal and, thus, well suited to RD problems (Cheng, Fan, & Marron, 1997).[17]

The bandwidth is a relatively more important decision given the trade-off between estimation bias and variance. To select the optimal bandwidth, we use the data-driven procedure proposed by Imbens and Kalyanaraman (IK) (2012). We however check whether statistical inference is robust to alternative bandwidths around the optimal bandwidth, namely 75 per cent and 125 per cent of the optimal bandwidth.

5. Data and Sample

5.1 Data

Baseline data come from the phase-4 application records and SLQAT test records collected and maintained by PEF. The data are obtained from only properly completed forms received by PEF before the announced deadline of July 2007. PEF collected 1,430 properly completed application forms in phase 4.[18]

PEF constructed school-level electronic databases to store applicant information. The data included school characteristics (location, gender type, level, physical infrastructure, and registration status), total school enrolment by gender, total number of teachers and administrative staff by gender, and the minimum and maximum monthly teacher salaries in the school.[19] These databases serve as the source of baseline data for the following outcomes measured at the school level: number of students, teachers, classrooms, and toilets. School-level outcomes of student-teacher and student-classroom ratios were also constructed using the data on numbers of students, teachers, and classrooms. The databases also serve as the source of baseline data on school-level covariates, namely location, gender type, level, and registration status.

The SLQAT pass rate serves as the treatment assignment variable z. PEF constructed electronic databases for SLQAT takers, containing the total score for each test-taker. Student test scores were organised by school, and within each school, by grade. The school identification information in the databases included the school's name (and occasionally some address elements) and location (tehsil and district).[20] We use the student test score data to calculate our own school SLQAT pass rates. Our calculations and PEF's match almost perfectly, at 99.5 per cent. We use our pass rates for the analysis.

Constructing a single electronic database for this analysis required linking the application data to the SLQAT data at the school level. School identification variables were not consistent across databases. Consequently, an iterative visual-matching process was used to link the two databases. First, schools were matched across databases using the district name and school name.[21] Exact matching failed in a number of cases due to inconsistencies in spelling, word order, and completeness of the school's name. In these cases, we matched on the basis of key words and word patterns. In cases in which a unique school record could not be found, the set of matching variables was extended to include school address wherever possible. This extension helped resolve a number of questionable cases. On the basis of this exercise, 94 per cent of school records in the SLQAT databases were linked to school records in the application database, yielding a sample size of 830 schools. We call this sample the 'SLQAT sample'.

Follow-up data come from a field survey administered to schools with SLQAT pass rates between $\pm$ 15 percentage points of the cut-off in May 2009, 17 months after phase-4 programme schools received their first subsidy payment. The school sample size within the selected pass rate range is 319 schools. This number constituted 38 per cent of the SLQAT sample and is referred to as the 'cut-off neighbourhood sample'.

At each sample school, the field survey interviewer collected information from school administrators or head teachers on the number of students, teachers, classrooms, and toilets, among other variables. Out of the 319 schools in the cut-off neighbourhood sample, 303 schools (95%) participated in the field survey. The remaining schools were visited but were found to be permanently or temporarily closed. Closure rates of marginal failers and marginal SLQAT passers are similar.

5.2 Sample

Table 3 presents the distribution of schools by selected characteristics measured at baseline for the SLQAT sample, the full cut-off neighbourhood sample, $z \in [52, 82]$, and a narrower cut-off neighbourhood sample, $z \in [62, 72]$. Two patterns are evident. First, across the three samples, the distributional patterns for the characteristics are broadly comparable. For example, the majority of schools are middle schools (69–72%), coeducational (83–87%), officially registered (81–84%), and rural (59–61%). Second, the distributional patterns for the characteristics are similar for the two cut-off neighbourhood samples.

Table 4 presents means and standard deviations for the outcomes of interest measured at baseline, again separately for the SLQAT sample and the two cut-off neighbourhood samples. In the SLQAT sample, schools had, on average, 222 students, 9 teachers, 8 classrooms, and 3 toilets. Average student-teacher and student-classrooms ratios were 26:1 and 28:1, respectively. These ratios were already at baseline below the stipulated maximums required for programme participation. Relative to the SLQAT sample, schools in the cut-off neighbourhood samples appear to be slightly larger. Mean outcomes are similar across the two cut-off neighbourhood samples.

6. Results

6.1 Model Specification Tests

The literature on RD estimation suggests several specification tests (see, for example, Imbens & Lemieux, 2008). First, we test whether there is any discontinuous change in the conditional

Table 3. Distribution of schools by selected characteristics at baseline, SLQAT and cut-off neighbourhood samples

Characteristic	SLQAT sample $z \in [0, 100]$ (1)	Cut-off neighbourhood samples $z \in [52, 82]$ (2)	$z \in [62, 72]$ (3)
Level			
Primary	0.12	0.12	0.12
Middle	0.72	0.70	0.69
Secondary	0.16	0.18	0.19
Gender type			
Coeducational	0.87	0.86	0.83
Girls only	0.08	0.08	0.08
Boys only	0.05	0.06	0.08
Registration status			
Registered	0.81	0.83	0.84
Unregistered	0.19	0.17	0.16
Location			
Urban	0.41	0.41	0.39
Rural	0.59	0.59	0.61
District			
Bahawalnagar	0.11	0.09	0.07
Bahawalpur	0.20	0.21	0.18
Jhang	0.11	0.14	0.18
Lodhran	0.12	0.09	0.13
Multan	0.16	0.20	0.10
Muzaffargarh	0.20	0.17	0.18
Rajanpur	0.10	0.09	0.14
N	830	319	120

Table 4. Summary statistics of outcome measures at baseline, SLQAT and cut-off neighbourhood samples

	SLQAT sample	Cut-off neighbourhood samples	
Outcome measure	$z \in [0, 100]$ (1)	$z \in [52, 82]$ (2)	$z \in [62, 72]$ (3)
Students	221.66	231.76	234.73
	(104.87)	(108.17)	(108.12)
Teachers	8.99	9.31	9.35
	(3.70)	(3.76)	(3.68)
Classrooms	8.42	8.6	8.79
	(3.82)	(3.75)	(3.59)
Toilets	2.95	2.97	3.18
	(1.94)	(1.75)	(2.24)
Student-teacher ratio	25.56	25.54	25.74
	(9.00)	(8.25)	(7.88)
Student-classroom ratio	27.99	28.25	28.30
	(11.58)	(11.50)	(12.11)

Notes: Standard deviations in parentheses. z denotes the treatment assignment variable, the SLQAT pass rate.

probability of treatment at the SLQAT pass rate cut-off, given that the suitability of the RD model hinges on this feature of the data. Second, we test whether the density function of the SLQAT pass rate exhibits local smoothness at the cut-off. Third, we test the identifying condition that the conditional mean untreated outcomes at the cut-off exhibit local smoothness using our baseline data on outcomes.

6.2 Discontinuity in the Probability of Treatment at the Cut-off

Figure 1 plots local linear regression functions for the probability of treatment estimated separately above and below the cut-off for schools in the cut-off neighbourhood sample using the follow-up survey data. As expected, the probability of treatment jumps discontinuously from 0 to 1 at the cut-off. This pattern in the conditional probability of treatment motivates our selection of a sharp RD design for the phase-4 SLQAT sample.

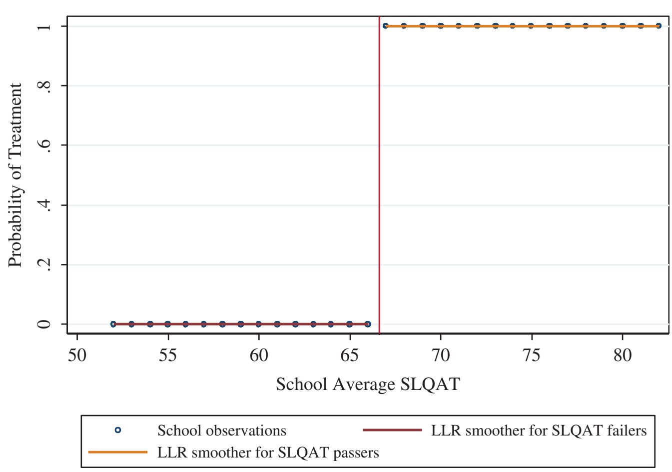

Figure 1. Probability of treatment, cut-off neighbourhood sample.

6.3 Local Smoothness in the Density Function of SLQAT Pass Rates

Rejection of local smoothness in the density of pass rates at the cut-off may suggest manipulation of pass rates. To assess this, we implement a test proposed by McCrary (2008) by separately estimating kernel density regressions below and above the cut-off point. We cannot reject smoothness in the density of pass rates at the cut-off.[22]

6.4 Local Smoothness in Conditional Mean Outcomes at Baseline

As a direct test of the identifying assumption, we examine whether mean outcomes measured at baseline satisfy local smoothness at the cut-off. Table 5 reports RD impact estimates of baseline mean outcomes at the cut-off based on local linear regressions for the optimal bandwidth (Column 1) and, as a robustness check, for 75 per cent and 125 per cent of the optimal bandwidth (Columns 2 and 3, respectively). Accompanying the table, Figure 2 plots the estimated local linear regressions for the outcomes, using the optimal bandwidth. In general, we do not find robust evidence to reject local smoothness at baseline. The one exception is classrooms: independent of the bandwidth (75%, 100% and 125% of optimal bandwidth), we find robust evidence that marginal failers have more classrooms on average than marginal passers at baseline.

6.5 RD Impact Estimates

Table 6 presents our RD impact estimates using the follow-up field survey data. The estimations are based on local linear regressions for the optimal bandwidth (Column 1), as well as for 75 per cent and 125 per cent of the optimal bandwidth (Columns 2 and 3, respectively). Accompanying the table, Figure 3 plots the estimated local linear regressions for the outcomes, using the optimal bandwidth.

We find robust evidence of significant positive impacts on the number of students, teachers, and classrooms among marginal passers. We also find robust evidence of a significant negative impact on student-classroom ratios among marginal passers. The figures show a discernible structural change in the mean levels for these outcomes marginally above and below the cut-off. The most conservative estimates of impacts at the cut-off across the alternative bandwidths are 136.6 additional students

Table 5. Local smoothness in conditional mean outcomes at baseline

	Cut-off neighbourhood sample		
Outcome measure	h (1)	$0.75 \times h$ (2)	$1.25 \times h$ (3)
Students	–26.976*	–40.965***	–21.817
	(16.04)	(15.42)	(15.87)
Teachers	–0.688	–0.781	–0.607
	(0.55)	(0.50)	(0.58)
Classrooms	–1.029***	–1.414***	–0.839***
	(0.34)	(0.48)	(0.29)
Toilets	–0.272*	–0.321**	–0.252
	(0.14)	(0.16)	(0.16)
Student-teacher ratio	–0.017	–0.706	0.279
	(0.89)	(0.97)	(0.86)
Student-classroom ratio	1.261	0.968	1.213
	(1.40)	(1.35)	(1.34)

Notes: * denotes statistical significance at the 10 per cent level; ** at the 5 per cent level; and *** at the 1 per cent level. Sharp RD impacts estimated via local linear regressions with triangular kernel. h denotes optimal bandwidth determined via the method proposed by Imbens and Kalyanaraman (2012). Robust standard errors clustered at the district level reported in parentheses.

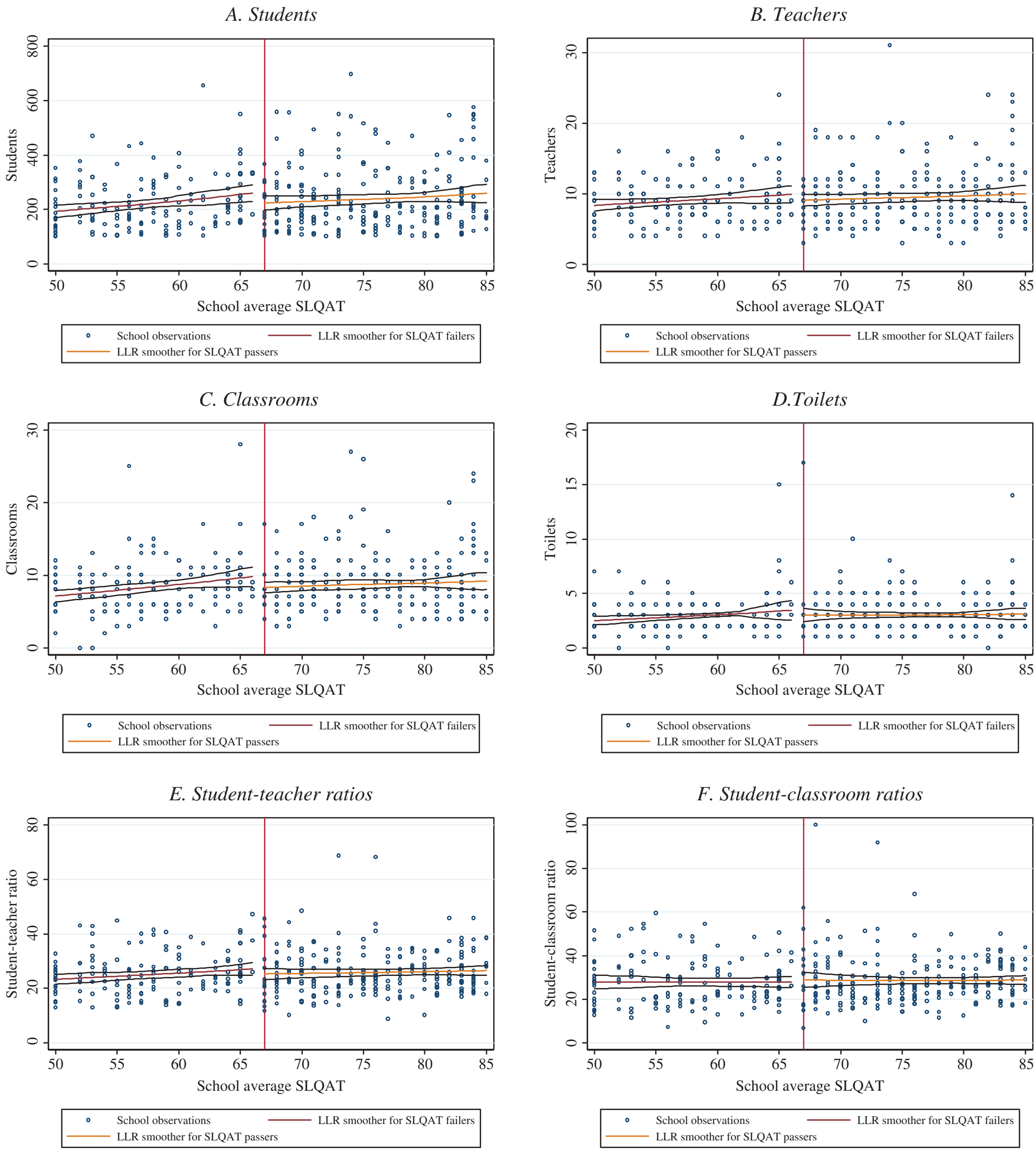

Figure 2. Local smoothness in conditional mean outcomes at baseline.

(or +59%, relative to the baseline mean for the outcome in the cut-off neighbourhood sample), 4.3 additional teachers (+46%), and 4 additional classrooms (+47%) and 4 less students per classroom (–14%).

We do not find robust evidence of impacts at the cut-off on the number of toilets and student-teacher ratios. The lack of a positive impact on the number of toilets is a concern given the large expansion in enrolment for marginal passers. The finding may suggest that PEF does not emphasise adding toilets as much it does other types of physical infrastructure, such as classrooms. Given the expansion in enrolment in marginal passers, the lack of an impact on student-teacher ratios suggests that programme schools have expanded the number of teachers in lock-step with enrolment increases. This behaviour may be driven in large part by PEF's condition that programme schools maintain these ratios below stipulated levels. The ratios were already below these levels at baseline.

Table 6. Discontinuity estimates of conditional mean outcomes using follow-up survey data

	Cut-off neighbourhood sample		
Outcome measure	h (1)	$0.75 \times h$ (2)	$1.25 \times h$ (3)
Students	138.52***	136.56***	151.66***
	(39.55)	(41.42)	(39.33)
Teachers	4.77***	6.33***	4.25***
	(1.61)	(1.96)	(1.46)
Classrooms	6.22**	5.31**	4.01**
	(2.45)	(2.84)	(1.89)
Toilets	0.86	–0.10	0.52
	(1.41)	(0.57)	(0.76)
Student-teacher ratio	–1.42	–6.12***	1.00
	(1.90)	(1.31)	(1.74)
Student-classroom ratio	–12.26***	–16.75**	–4.00*
	(3.88)	(7.68)	(2.08)

Notes: * denotes statistical significance at the 10 per cent level; ** at the 5 per cent level; and *** at the 1 per cent level. Sharp RD impacts estimated via local linear regressions with triangular kernel. h denotes optimal bandwidth determined via the method proposed by Imbens and Kalyanaraman (2012). Robust standard errors clustered at the district level reported in parentheses.

6.6 Falsification Test: RD Estimates at False Cut-offs

As a falsification test, we estimate RD impact estimates using the follow-up field survey data at two arbitrarily-selected false cut-offs: 57 per cent and 77 per cent. The estimations are based on local linear regressions for the optimal bandwidth, as well as for 75 per cent and 125 per cent of the optimal bandwidth. The false cut-offs are equidistant from the true cut-off of 67 per cent. We expect to find local smoothness in the conditional mean outcomes at these cut-offs. The subsample for the investigation at 57 per cent is schools with SLQAT pass rates between 52 per cent and 66 per cent. Likewise, the subsample for the investigation at 77 per cent is schools with SLQAT pass rates between 67 per cent and 82 per cent. We do not find robust evidence to reject local smoothness in the conditional mean outcomes at both false cut-offs.[23]

6.7 Cost-Effectiveness Estimates

We estimate the cost-effectiveness of the programme in relation to enrolment gains using two alternative methods. First, using the conservative estimate of the impact on enrolment (137 students), we derive the annual rupee cost of one additional student in a programme school *induced* by the programme. Given a baseline mean school size of 232 students for schools in the phase-4 cut-off neighbourhood sample (which we treat as the number of children who would have attended the programme school in the absence of the treatment) and an annual subsidy amount of 3,600 rupees (US$42.4) per student, it costs 9,696 rupees (=3,600 × (232 + 137)/137) (US$114) to induce an additional student per year.[24] In comparison, this cost is less than one-third of the cost of inducing an additional student per year through conditional cash transfers to female students in public secondary schools in Punjab (Andrabi et al. 2008).

Second, following the approach by Evans and Ghosh (2008), we calculate the programme's cost-effectiveness by deriving the annual per-student cost of increasing enrolment in programme schools by one per cent. Using an annual subsidy of 3,600 rupees per student and the impact estimate on enrolment of 59 per cent, we estimate a cost-effectiveness ratio of 61 rupees (=3,600/59) (US$0.72). This estimated cost-effectiveness ratio compares extremely favourably with ratios of

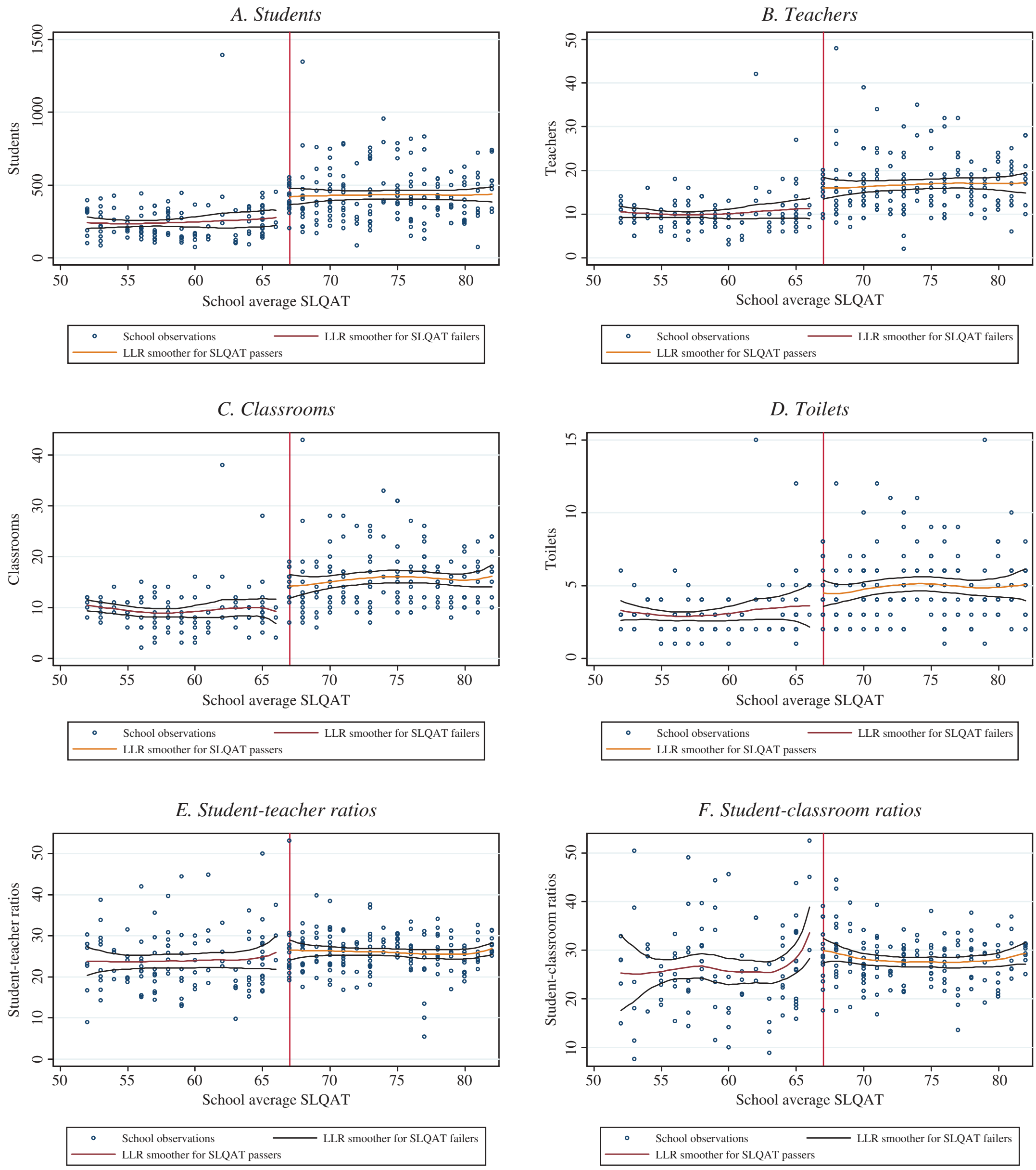

Figure 3. Local discontinuities in conditional mean outcomes using follow-up survey data.

other evaluated education interventions across the developing world as reported in Evans and Ghosh (2008). In fact, the estimated ratio for the FAS programme ranks among the very lowest.[25] What is more, our estimated ratio surprisingly mirrors Evan and Ghosh's estimated ratio for the per-student subsidy programme in Balochistan, Pakistan (see Kim et al., 1999) noted in Section 1.

7. Conclusion

In this paper, we estimate the impacts of accountability-based public per-student subsidies to low-cost private schools in Punjab, Pakistan on student enrolment and school inputs. Given poor public sector accountability, whether the government can hold partnering private schools accountable for complying with programme conditions is an open question. For SLQAT takers in phase 4, we find robust evidence from applying a sharp RD design to the data that the programme significantly increased the number of students, teachers, and classrooms and reduced student-classroom ratios among marginal passers. The impact estimates at the cut-off are sizable: our conservative estimates indicate that, within 17 months, the programme expanded marginal passers by, on average, 137 students (+59%, relative to the mean baseline value for the outcome for cut-off neighbourhood sample), 4 teachers (+46%), and 4 classrooms (+47%) and reduced student-classroom ratios by, on average, 4 students per classroom (–14%). Cost-effectiveness estimates suggest that the programme is among the cheapest interventions in developing countries for inducing enrolment gains.

Two potential threats to the internal validity of impact estimates are present. These threats arise from design and implementation features of the programme. The first threat is from programme spillovers to nonprogramme schools (of which marginal nonpassers are but a specific subset) that operate in the same local schooling markets as programme schools. Design features of the programme such as the free-schooling condition to maintain programme benefits can alter the terms of local market competition. By giving programme schools a competitive edge vis-à-vis nonprogramme schools, impact estimates may be upwardly biased if, for example, they induce students (and also teachers) to shift from nonprogramme to programme schools. This in turn would lead to the shrinking (or, at an extreme, the shutdown) of nonprogramme schools and/or discourage investments in the quantity and quality of inputs. On the other hand, the altered terms could downwardly bias impact estimates if they induce nonprogramme schools to adapt to the competition, for instance, by ratcheting up investments in the quantity and quality of infrastructure and staff and/or altering fee structures to retain existing students and attract new students. Both types of effects could be present simultaneously. Consequently, the direction of the net effect is theoretically ambiguous.

The second threat arises from anticipation of future treatment. Programme entry is not a one-off event. To date, there have been nine calls for applications over an eight-year period. Given this pattern, it is conceivable that nonprogramme schools interested in joining the programme might alter their behavior in anticipation of a future call for applications in an effort to increase the likelihood of programme entry. These actions could, for example, take the form of nonprogramme schools investing in more and better quality inputs and resources. Anticipation in this case would result in impact estimates being downwardly biased. In particular, behavioral changes due to anticipation might be most applicable to nonprogramme schools which failed to achieve the SLQAT pass rate cut-off in an earlier phase of entry (our marginal failers), as we would expect that the marginal costs of investments and efforts required for failers from a previous phase are likely to decrease as one approaches the cut-off from below.

When the RD model is applied to the correct data designs, it yields internally-valid estimates. However, the generalisability of these impact estimates is likely to be limited given that, in principle, they are only valid for narrowly-defined subpopulations. In the case of the phase-4 SLQAT test takers, the RD impact estimates are valid for low-cost private schools that successfully applied to the programme, cleared the physical inspection, and obtained pass rates near the SLQAT cut-off. Even if we generalise our estimated impacts to be the average over the full range of SLQAT pass rates, the further generalisability of the impacts is limited by sample selection, since the SLQAT pass rate is only available for those schools which followed the three-step application process in the seven main programme districts. This sample of schools may not be representative of low-cost private schools in programme districts, let alone the larger population of low-cost private schools nationally. Given what we know about the steps preceding the SLQAT, the extent to which the sample of SLQAT takers diverges from the population of low-cost private schools is largely determined PEF's physical inspection screening. Evidently, this screening has bite: as mentioned before, only 61 per cent of schools inspected cleared the inspection and took the SLQAT in phase 4.

To end, the estimated impact on enrolment must be interpreted cautiously given that we do not establish the extent to which the documented enrolment gains translate into school participation gains. If schools that join the programme become more attractive vis-à-vis other schooling options, the programme is likely to induce both displacement and diversion effects: some share of the new enrolment in the programme school will likely come from students already enrolled in other schools or children that where initially considering enrolling elsewhere. Understanding whether the programme has produced aggregate welfare gains for households requires more information than we were able to gather for this evaluation. It also requires a more complex analysis. Specifically, we would need to evaluate the welfare distribution of households in the schooling markets which marginal failers are part of vis-à-vis the welfare distribution of households in the schooling markets which marginal passers are part of, with a clean separation between the markets of marginal failers and the markets of marginal passers. Given free choice for households, the enrolment gain in programme schools suggests a welfare gain from households re-optimising (under their same constraints households originally faced) in favour of programme schools. If welfare is measured in terms of, say, monetary costs of schooling, holding everything else constant, we predict that the elimination of school fees in programme schools generates aggregate welfare gains for households. If welfare is measured in terms of, say, student academic achievement, holding everything else constant, we predict that higher student academic achievement – induced by, among other things, the minimum QAT pass rate condition for continuing programme eligibility – also generates aggregate welfare gains for households.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. The net enrolment rates at the primary, middle, and high school levels cover enrolment in grades 1 to 5 by children ages 6 to 10, enrolment in grades 6 to 8 by children ages 11 to 13, and enrolment in grades 9 and 10 by children ages 14 and 15, respectively.
2. PPP initiatives are increasingly perceived in international policy circles as a promising mechanism for attaining key education goals (World Bank, 2009). In addition, opportunities for introducing PPP programmes of medium to large scale are emerging in several developing countries (for example, India, Kenya, and Nigeria) as the private education sector matures and becomes an important player in service delivery.
3. Primary schools are composed of grades 1 to 5. Middle schools are composed of grades 1 to 8 or 6 to 8. Secondary schools are composed of grades 1 to 10, 6 to 10, or 9 to 10.
4. Own estimate based on data from the 2004/2005 Pakistan Social and Living Standards Measurement survey.
5. It is conceivable that much of the growth and change in the private school system is a direct response to the rigidities and shortcomings in the public school system.
6. The exchange rate in 2000 was 41 rupees per US dollar.
7. The information on the programme presented in the paper reflects programme design and administration until 2009.

8. In this and following sections, the exchange rate used for the conversions is 85 rupees per US dollar (effective March 2011). When the programme was introduced in 2005, the exchange rate was roughly 60 rupees per US dollar; the rupee has steadily weakened since then.
9. The programme also offers two cash bonuses. The first is a teacher bonus for a high level of school test performance. Once every school year, in programme schools where at least 90 per cent of students in tested classes obtain a score of 40 per cent or higher in the QAT, up to five teachers selected by the school's administration each receive an award of 10,000 rupees (US$118). The second is a competitive school bonus for top school test performance. Once every school year, in each of the seven main programme districts, the programme school with the highest share of students with a score of 40 per cent or higher in the QAT is awarded 50,000 rupees (US$588).
10. The exact subsidy amount was guided by a survey conducted by PEF in 2005 in selected districts, which showed that the vast majority of private schools that operate in rural areas and disadvantaged urban neighbourhoods charge between 50 to 400 rupees per month (US$0.6 to 4.7) in fees. Based on this information, the subsidy amount was set at the upper-segment of this price range (Malik, 2007).
11. For schools that entered the programme in phases 1 and 2, step 2 was the final entry step.
12. Our own tallies based on the SLQAT data deviate slightly from the above numbers. We find that 856 schools took the SLQAT and, out of these, 432 schools achieved the minimum pass rate in phase 4.
13. The QAT is a 65-minute, written, curriculum-based test. It is administered twice a year in October–November (in the first term) and February–March (in the second term). Tested subjects are English, Urdu, mathematics, and science (general science in grades 1–8 and biology, chemistry, and physics separately in grades 9–10). The same procedures used to administer the SLQAT are largely followed with the QAT. One important difference is that, unlike with the SLQAT, the programme school receives formal advance notice of the date of the QAT, and at least 80 per cent of its students are expected to be in school on the day of the test.
14. There are also other conditions for continuing benefit eligibility. These include (1) registering the school with the District Registration Authority within one year of joining the programme; (2) conducting only one class in a classroom in any period; (3) maintaining or upgrading the quality of the school's physical infrastructure (for example, adequate classroom space, properly-constructed rooms and buildings, sufficient ventilation, and sufficient artificial and natural light); (4) acquiring and maintaining adequate furniture and teaching tools (for example, benches, desks, and blackboards); (5) providing monthly reports to PEF on enrolment counts; (6) keeping student-teacher and student-classroom ratios below 35:1; (7) keeping enrolment above 100 students; and (8) not holding after-hours classes or tutoring services at the school. These additional conditions are applied more leniently. Typically, when PEF detects a violation among this subset of conditions, schools are provided with a warning and a grace period within which to comply. To date, no programme schools have been disqualified for repeated violations of these conditions.
15. PEF reports that the three schools were problematic from the outset; the schools were ejected from the programme for general noncompliance and nonperformance.
16. Schools that took the phase-3 SLQAT and failed had another opportunity to seek entry when phase 4 was announced. As a result, some phase-3 SLQAT 'failers' reapplied to phase 4, cleared the physical inspection, retook the SLQAT, and passed it. In the working paper, we also present fuzzy RD impact estimates for phase-3 programme schools.
17. While more sophisticated kernels are available, they do not provide any significant gain in asymptotic bias reduction. In general, parameter estimates appear to be robust to the choice of kernel (Imbens & Lemieux, 2008).
18. The total number of unique applications received by PEF is unknown as all rejected applications were discarded.
19. As part of this inspection, the information provided by the school on the application form was verified. These inspection data would have been useful for checking the accuracy of the application data. They were however collected in paper form and not entered into an electronic database. Consequently, these data are unavailable for the purpose of this study.
20. Tehsil is the geographical unit of government administration one tier below district. There are 127 tehsils in Punjab.
21. Although information on the school's tehsil was also available in both the application and test databases, this information was error-ridden. Consequently, this information was not used in the cross-database matching exercise.
22. Test results are available from the authors upon request.
23. Falsification test results are available from the authors upon request.
24. The annual subsidy amount per student is roughly equal to the annual *programme amount* per student, as the per-student amounts for programme administrative costs and the teacher and school bonuses add less than 1 per cent to the amount. This is principally due to the large number of students currently covered under the programme.
25. This result remains qualitatively unaltered if we precisely follow the currency conversion and inflation adjustments steps taken by Evans and Ghosh to fix all ratios in 1997 US dollars.

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