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Public Infrastructure, Location of Private Schools and Quality of Schooling in an Emerging Economy

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Public Infrastructure, Location of Private Schools and Quality of Schooling in an Emerging Economy

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***Abstract*:** The present paper argues that local public infrastructure exerts a significant and positive effect on the presence of private school as well as the quality of schooling in the Indian villages. Given historical distribution of land and ethnic composition, villages with more unequal distribution of land are more likely to have better access to public infrastructure (for given level of ethnic fractionalization), which in turn enhances the likelihood of having a private school in the village. Results using PROBE survey of household-, school- and village-level data from five north Indian states provide some support to this central hypothesis. There is also evidence that the quality of overall schooling is generally better in villages with a private school; rise of private schools however fails to affect the quality of local state schools.

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1. Introduction

The market for schooling is changing in India's emerging economy. While public providers traditionally dominate the supply side, a growing number of private providers are entering the schooling market, frequently giving rise to coexistence of public and private providers in the same locality (Public Report On Basic Education or PROBE in short, 1999). A changing structure of the education market may affect the productivity/performance of schools through changing behaviour of market participants, namely, schools and parents/students. In this context, the present paper examines the location decisions of private providers and the resultant effects of presence of private school on quality of government schools as well as overall average school quality in the locality. The analysis is based on the household-, school- and village-level data from five states included in the PROBE survey including Bihar, MP, Rajasthan, UP and HP (for details of data see Drèze and Kingdon, 2001).

There is a sizeable literature that identifies the effects of demand and supply factors contributing to low levels of literacy in India. This literature highlights the role of household resources (Pal, 2004), gender gap in school enrolment and attainment attributable to low returns to female education (Kingdon, 1998), parental preferences and opportunity costs of schooling (Pal, 2004) as well as poor quality of state-schooling (e.g.,

see Drèze and Kingdon, 2001; Muralidharan and Kremer, 2006) including teacher's absenteeism, lack of education materials, discriminatory behaviour of teachers and peers. In this process, the role of private fee-charging schools has largely been overlooked despite their growing importance in the past two decades or so. There are only a limited number of attempts to examine the relative efficiency of public and private schooling in India.[1] For example, Kingdon (1996) found that there was little difference in performance between private aided (PA) and government schools in urban UP while private unaided (PUA) schools performed significantly better. Bashir (1994), however, indicated that students in PUA schools had better Mathematics achievement, but less achievement in Tamil language, [2] compared to government school students in Tamil Nadu.[3] PA schools however did better in both subjects than state schools. More recently, using a nationally representative survey conducted in 2003 from the major Indian states, Muralidharan and Kremer (2006) argued that private schools are more common in areas of failing public schools, highlighting the differences in the nature of inputs used by government and PUA schools.

The present paper goes beyond the existing literature in terms of objectives, methodology and therefore its results. We argue that the location choice of private schools crucially depends, among other things, on the levels of local public infrastructure.

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[1] There is however a sizeable literature on school choice and competition in developed countries, especially for the US. For example, see Hoxby (1994), Epple and Romano (1998).

[2] One possible factor attributing to the inferior performance of PUA schools may be the selection of those PUA schools that specialised in English as a medium of instruction (and thus had less hours devoted to Tamil teaching).

[3]There is however no consensus in the literature about the effects of school type on school quality. For example, Newhouse and Beegle (2005) found that students from public secondary schools perform better than comparable privately schooled students in Indonesia while Bedi and Garg (2000) argued that graduates of private secondary schools perform better in the labour market in the same country.

In particular, more developed villages close to district head quarters and pucca (concrete) road and also with access to piped water, electricity, phone and post-office are more likely to be chosen by private schools as well as better off households (those with more education and/or belonging to higher caste) while remote villages deprived of many of these public infrastructural facilities are generally overlooked by the private providers and better off households. The latter does not necessarily imply a high rate of migration from less developed to more developed villages in the state; in fact rural-to-rural migration within a state is rather low (less than 5% of the population) and majority of the migrants are women who move to husband's place after marriage. In stead our analysis highlights the historical concentration of better off households in more unequal villages who tend to lobby more public goods in the same way they lobby for a private school. Secondly, presence of private schools in villages with access to better public infrastructure tends to give rise to higher average pass rates while presence of local private schools fails to have a perceptible impact on the pass rates of state schools in the village.

The latter highlights the role of public capital and infrastructure on private productivity. The 'public capital hypothesis' (a la Aschauer, 1989, 1997, Barro, 1990) argued that investment in non-military public capital had both direct and indirect influence on national output, as public capital makes private inputs more productive. In particular, public capital raises the marginal product of private inputs (both labour and capital), which raises the perceived rate of return on private investment. Indirectly, public infrastructure (e.g., good road network) may also lower production costs of private firms and thus the expected rate of return on private investment. There may however be some

crowding out of private investment, especially if increased investment in public capital and infrastructure is financed through an increase in distortionary taxes, thus lowering the expected net rate of return to private investment. While the regional scientists have emphasized the role of investment in public infrastructure to enhance regional competitiveness (e.g., Vickerman, 1990), role of poor infrastructure has received relatively little attention to explain the lopsided development in developing countries (with the exception of Reinikka and Svensson, 2002).[4]

Our analysis is based on the household-, school- and village-level PROBE data-set collected in 1996 from five north Indian states including Bihar, Uttar Pradesh (UP), Madhya Pradesh (MP), Rajasthan and Himachal Pradesh (HP). An important concern of the paper is to identify an exogenous instrument of village infrastructural facilities. In order to address this we proceed as follows: (i) we first compute a weighted average of access to various public infrastructure in a village, using principal component analysis. (ii) Next following the recent political economy literature (for a survey see Pal and Ghosh, 2007), we determine the village's access to this composite measure of village infrastructure, using distribution of land and ethnic heterogeneity in the locality (see further discussion in section 2.2) and use the predicted value of the regression as a possible exogenous instrument of village-level infrastructural facilities. Finally, we determine the presence of a private school (as a function of village infrastructure among others) as well as quality of schooling (as a function of presence of private schools) in a village. In doing so, we try to minimize the possible endogeneity biases present in the estimates and search for the best instruments, which is clearly limited by the single cross-

[4] There is however a growing literature on the provision of public services like health and education in developing countries (e.g., Chaudhury et al. 2005).

section information at our disposal. Access to village infrastructure is instrumented by the predicted village infrastructure (see section 2.2) while presence of private school is instrumented by its predicted value (see sections 3.1 and 4.1). Results suggest that private schools are more likely to be present in villages with better infrastructural facilities and also that the access to private schools is associated with better average quality of schooling in the village, while the quality of local state schools remains unaffected.[5] Allowing for the measurement errors in the instruments used, we are likely to overestimate the impact of private schools on school quality since private schools tend to locate in places where unobserved parents' tastes/preference for education are higher; thus the estimates obtained would be an upper bound of the true effects.

The analysis is developed as follows. Section 2 discusses the data while section 3 explains the hypotheses and methodology. Section 4 presents and analyses the results and the final section concludes.

2. Data and Methodology

2.1. Data

One important reason for the lack of research on public and private schools in India has been the scarcity of appropriate school-, village- and/or district-level data for private and public schools across the Indian states. Among the existing studies, Bashir (1994) studied the case of Tamil Nadu while Kingdon (1996) focused on urban UP. Muralidharan and

[5] Note however that our analysis based on single cross-section data cannot control for the possible correlation between infrastructure development and the unobservable determinants of school quality over time.

Kremer (2006) has been the first study based on their own survey data that examines the issue of rise of private schools across a sample of major Indian states. One could in principle try to use the recently released district-level Seventh round of All India School Education Survey (AISES) data collected in 2002-03. There are however some problems to use this data-set for our purpose: first, the survey focuses on collecting very detailed inputs from schools under different management (government, private aided, private unaided, local body etc.), but does not have any information on student performance. Second, AISES data only focuses on the recognized schools in India while a large number of new private schools in the Indian states remain unrecognized (e.g., see Table 3). Finally, AISES data do not have any information on the household characteristics of children studying in schools under different types of management. In the absence of any better alternative source, the present paper makes use of the school- village- and household-level information obtained from the PROBE survey data (for details of the data, see Dréze and Kingdon, 2001) collected during September to December 1996. Although somewhat dated, this data covers households, schools and villages drawn from five Indian states including four of the country's worst performing states, namely, Bihar, MP, Rajasthan and UP; the fifth state is a much better-off state Himachal Pradesh (HP). The sample of schools in the PROBE survey includes both recognized and non-recognised schools under different management. Although the sample size is small, the amount of information we have for the schools (various inputs as well as indicator of performance), households and villages is quite unique and not generally available in any existing surveys. Moreover, this sample focuses on some of the worst performing states and the coexistence of private and state schools in our sample gives us an opportunity to

study the endogenous location choice of private schools and its effects on the quality of schooling in the sample villages that remain rather unexplored in the Indian context.

In order to explore the correspondence between supply and demand for private schools, we also make use of the household-level data collected from 123 sample villages[6] (part of the PROBE data used by Dréze and Kingdon, 2001). This part of the data gives information on enrolment of children (current enrolment as well as children ever-enrolled) aged 5-18 years born to sample households residing in the sample villages.

Four of the PROBE states namely Bihar, MP, Rajasthan and UP were relatively poorer compared to the more affluent state of Himachal Pradesh (HP). There are 290 schools surveyed across five states. Among these 290 schools, 45 schools (i.e., 16%) were under private management.[7] Note that this includes both private *recognised* (36%) and *uncrecognised* (64%) schools with a primary section attached to it.[8] Hindi or Urdu has been the medium of instruction in about 90% of these sample schools under private management; less than 5% of these schools used English as the medium of instruction.[9] Thus unlike some existing literature (e.g., Munshi and Rosenzweig, 2006), the medium of instruction was not significantly different between private and government schools included in the PROBE survey. Both state and private schools in our sample tend to cater to elementary education at the primary level.

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[6] Note that the total number of schools in the school data-set is 290 while the number falls to 170 when we consider 123 sample villages from which household data was collected in the PROBE survey (see column 2 of Table 1). Information was collected from about 4500 children belonging to 1322 households residing in 123 sample villages in the PROBE states.

[7] This excludes the private schools receiving aid from the government.

[8] In some villages sample schools may however combine primary, junior and/or secondary education. In other words all private and state schools in the PROBE survey provided primary education, which is the focus of our analysis in this paper.

[9] PROBE survey does not however identify if some of the PUA schools were religious schools or schools organised by local NGOs.

Table 1 shows the distribution of state and private schools across the villages in the selected states. Clearly, public providers dominated the schooling market in that as high as 80% of the villages had only state-run schools (the proportion ranges between 75% in UP to 92% in MP). In contrast, the corresponding proportion of villages with private (recognised or unrecognised) schools is much lower[10] and very often private schools tend to be set up in a village with existing state-run schools.

Clearly there is significant variation in the rate of privatisation across the PROBE states (see Table 2): While 28% of UP villages have private schools with primary section, it is only 8% in MP in 1996. If however we compare these proportions with those observed by Muralidharan and Kremer (2006) for these states, the growth rate of privatisation appears to be remarkable in UP, Bihar and Rajasthan and MP over a period of 1996-2002/03; the rate of increase has however been rather modest in HP (see Table 3). Finally, the privatisation rate appears to be much smaller if we consider the figures obtained from 7th AISES for these PROBE states over the same period (also see Table 3). The difference could be attributed to the fact that AISES data focused only on the recognised schools; thus it follows that a much higher proportion of private schools in the Indian states, especially those in the worse-performing PROBE states, tends to be unrecognised and the difference is particularly striking for the state of Bihar. The latter further justifies our attempt to use the PROBE data that includes information on both recognised and unrecognised schools in the selected states.

The existing literature highlights the differential characteristics of state and private schools with respect to both school inputs and indicators of school performance. Table 3 summarises the differences in these inputs as well as school

[10] Also note that the number of private schools will be one in almost all cases, if at all.

performance indicators between state and private schools in our sample. The table also shows the corresponding t-statistics for mean differences in a set of key characteristics between these two categories of schools, when significant. There are significant differences in the input choice; for example, private school teachers are often younger and have more education, but often do not have any teacher's training.[11] These two groups of schools are also significantly different with respect to total enrolment, pupil-teacher ratio as well as pass rates in the class V Board Examination. In particular, total enrolment as well as pupils per teacher is significantly higher while pass rates are significantly lower in state schools.

2.2. Access to village infrastructure

Access to village-level public infrastructural facilities plays a crucial role in our analysis. In particular, we observe if the village has access to piped water, electricity, phone and post office. We also know the distance of the village from the nearest pucca road and the district head quarter. Using principal component analysis, we construct a composite village development index, which is a weighted average (Bartlett score) of the village's access to piped water, electricity, phone and post office. Table 2 compares the average village-level public infrastructural facilities in the PROBE data, among others, in the sample states and highlights the extent of inter-state variation in this respect. On an average, villages in HP are more developed with better access to public infrastructural facilities. In contrast, the other four states lie at the other end of the distribution not only in terms of access to many public infrastructural facilities, but also in terms of average

[11] Kingdon (1996) suggests that annual per pupil salaries of private school teachers were significantly lower than those spent on teachers in government or private aided schools. The latter seems to be compatible with their profit maximisation motive of private schools.

per capita state domestic product.

The question that may however arise at this point is whether one can treat access to public infrastructure in a village to be endogenous. In fact there is a growing political economy literature on public goods provision in the low-income countries, which identifies, ethnic fractionalisation and elite dominance as two crucial factors determining access to infrastructure. In general, there is confirmation from the Indian districts that more heterogeneous communities tend to be politically weaker and therefore are less likely to get the goods they want and more likely to get some of the inferior substitutes (e.g., see Banerjee and Somnathan, 2007). Second, following Bourguignon and Verdier (1999), Galor and Moav (2006), Pal and Ghosh (2007) find importance of land distribution on public spending on education. The underlying idea is that dominance of a landed elite may not support the human capital investment in the masses, the latter may undermine the dominance of the elite. Accordingly, we determine the composite index of village-level public infrastructure in terms of village land distribution (mean and standard deviation) and an index of ethnic fractionalisation (sum of square of population shares belonging to various caste/religion groups in the village). Results summarised in Appendix Table A1 do suggest that more ethnically diverse villages have less public infrastructure; however, more unequal villages (i.e., those with higher standard deviation of landholding) would have more public infrastructure, even if they are ethnically more diverse. In other words, there is some confirmation that villages with more unequal landholding tend to have more wealthy influential people, who may lobby for more public infrastructure, even if it is more ethnically diverse. Moreover, there is confirmation in our sample that these unequal villages tend to have more infrastructural

facilities. Accordingly we use the predicted value of composite index of village infrastructure as an instrument of infrastructure in our regression exercise.

2.3. Comparison of villages with/without private school

In this section we compare the demographic, socio-economic and school characteristics of the villages with and without private schools, which in turn highlights if there is any systematic difference between these two groups of villages. Results of a simple mean test summarised in Table 4 indicate that villages with private schools tend to enjoy better infrastructural facilities (as reflected in their access to piped water, electricity, phone, post office etc.). These villages are also significantly closer to the pucca road as well as the district head quarters. Second, villages with private schools tend to be larger (in terms of population) and have relatively more educated parents; these villages also have lower proportion of low caste and Muslim population, who are often poorer and also have less assets. In other words, there is suggestion that more unequal villages with better-off households and better public infrastructure tend to be chosen by private schools. It also follows that pass rates in class V Board examination (which can be taken to be a useful indicator of primary school quality) tend to be higher in the villages with private schools.

3. Hypotheses and Methodology

In the light of this preliminary analysis, we shall now formalise our hypotheses and methodology to determine the location decisions of private schools and also its effects on quality of schooling in our sample.

3.1. Location choice of private schools and households

Given that only about 16% of the sample villages in the PROBE survey had a private school, an important question would be to examine what determines the location choice of private schools. Note however that there has been a single private school, if at all, which in turn induces us to empirically determine a binary variable PRIVS that takes a value 1 if there is a private school in the village and zero otherwise. [12]

There are some underlying assumptions that we need to clarify here. First, it is assumed here that most private schools are recently established (for example, see Muralidharan and Kremer, 2006), i.e., state schools were established before the private schools.[13] Second, we assume that the provision of state education is exogenous (determined, e.g., by government policies). Accordingly, we determine the likelihood of having a private school in a village v located in the s-th state as follows:

$$P^{S}_{vs} = X'_{vs}\,\beta + \delta_s + \varepsilon_{vs} \qquad (1)$$

where X_{vs} includes the set of village-specific explanatory variables.

The set of explanatory variables X could account for a number of factors affecting the location decision of a private provider: first, the structure of the existing market may be an important determinant of private school presence. In this respect, we consider the quality of services provided by existing state schools in the village and include some important characteristics of existing state schools in a particular village, e.g., teachers'

[12] These include both government and private aided schools. These two types of schools are similar in many respects with both being entirely financed by the government and having little/no control over staffing (hiring/firing), curricula, teaching materials and budget allocation. The main difference between these two types of schools is that the latter are nominally privately managed, though there could be some inter-state variation in the management of PA schools. Private schools here refer to unaided (recognised and unrecognised included) schools.

[13] We however do not observe the year a school was founded.

attendance rate, absence of the head teacher (a binary variable), multigrade teaching and available infrastructural facilities in local state schools.[14] Second, public infrastructure is largely location specific, location choice of private firms, especially the smaller ones, may thus follow the location of public capital and infrastructure, thus minimizing some sunk costs of production. Our analysis in this respect highlights the potential role of village-level public infrastructure. We include the predicted value of composite index of public infrastructural facilities as a possible instrument for the access to public infrastructure. In addition, we include distance of the village from the nearest pucca road and also the district head quarter.

There may however remain a number of unobservable factors that may influence the presence of a private school in a village. Our estimates may be biased, if these are not accounted for. So long as these unobservables are state-specific, these are accounted for by including the state-specific unobservable fixed effects δ_s. In particular, economic prosperity of the state may be an important factor influencing both the demand for (e.g., through its effect on fertility) and the supply (e.g., government spending on state schools) of private schools in the state.

Given the binary nature of the dependent variable PRIVS, we use a binary probit model to determine presence of private schools in the market. Table 5 shows the estimates of two specifications: specification (1) includes only village-level characteristics (b) and state characteristics (c) while specification (2) includes all three sets of characteristics (a)-(c)

[14] We experiment with a number of characteristics of the existing state schools including absence of the head teachers, proportion of teachers present on the survey date, number of infrastructural facilities available, pupil teacher ratio, pass rates in class V board examination. Results shown in Table 5 represent the estimates of the parsimonious specification.

3.2. Accounting for the demand for private schools

A related question would be to analyse whether the presence of private school in a locality has been a response to the corresponding demand for private schools in the village schooling market. In this respect, we analyse the parental choice of private schools (as against state schools) in the sample villages. The latter will be determined, among others, by the characteristics of the individual child and its siblings, parental income/education as well as caste/religion[15], quality of local state schools (as reflected in teaching as well as infrastructural facilities offered) as well as the village infrastructural facilities.

To this end, we determine the likelihood that a local household i chooses to send a child to a private school in the village v located in the state s.

$$P^{d}_{ihs} = X'_{ivs}\gamma + \varphi_s + \varepsilon_{2ihs} \qquad (2)$$

The set of explanatory variables X includes the individual characteristics of the child (gender, age), characteristics of his/her siblings (proportion of younger male and female children aged below 18 years), his/her parents (education, caste/religion). We also include the characteristics of the local state school(s) (e.g., pupil per teacher, proportion of teachers present and also the number of infrastructural facilities available) as well as the infrastructural index (predicted) of the village. The underlying idea is that for given household income/education, child/siblings characteristics and village infrastructure, parental choice of private schools could be a response to the shortcomings of the local state schools, if any, which in turn may induce the private providers to supply

[15] Note that in the light of our discussion in section 3.1., we also assess the robustness of our results in terms of alternative instruments.

the services missing otherwise. Finally we include the state dummies to control for the unobserved state-level variation ϕ_s (e.g., see Table 3) in both enrolment and choice of private school equation.[16]

Given that a significant proportion of sample children are never enrolled[17], derivation of the demand for private school P^d_{ivs} needs to account for the possibility of ever-enrolment. Using PROBE household-level data, we thus use a simultaneous probit model to jointly determine the likelihood of ever-enrolment (a binary variable) and also whether a child attends a private school (a second binary variable). An alternative would be to use a bivariate probit model of parental choice of private school with selection for ever-enrolled children. Note however that the main difference between multivariate and bivariate probit model with selection is that the latter assumes a sequential decision process (parents first decide whether to enrol a child and then selecting the enrolled children decides whether to send an ever-enrolled child to a private school). One could however argue that these two decisions are determined simultaneously and not sequentially. Thus a multivariate simultaneous probit may be more pertinent in this context. These results are presented and discussed in section 4.2. In order to check the robustness, these simultaneous probit estimates are also compared with bivariate probit model with selection for ever-enrolment (which treats these two decisions as sequential).

[16] Note that the identifying variables in the two probit equations (ever-enrolment and parental choice of private schools) are village infrastructural index (predicted) and the sibling composition variables, i.e., the proportion of younger male and female children aged betweens 5-18 years; the latter would capture the household resource constraint effect, if any, especially relevant for the choice of private schools.

[17] Note that a significantly larger proportion of boys (60% as opposed to 40% of girls) are ever-enrolled in our sample while a larger proportion of ever-enrolled girls (19.6% as opposed to 15.6% of boys) go to private schools. If however we consider the proportion of total boys and girls going to private schools, the proportion is very similar (around 11% for both boys and girls).

3.3. Effect of school choice on school quality

Presence of private schools in villages with existing government-run schools offers more choice for parents, especially those who are not budget constrained. The latter naturally induces us to examine if the presence of private schools improves the quality of schooling in the locality (in comparison to the locality where there are only government schools), in general, and the quality of states schools, in particular. Note however that all the private schools in our sample prevail in the villages with at least one state school; thus, the presence of private school in a village is synonymous to the coexistence of state and private schools in our sample.

It is natural to argue that the presence of private schools would affect school quality through strategic response(s) of state schools. There is some literature on the game theoretic models of mixed duopoly/oligopoly where at least one public firm may coexist with at least one private firm (e.g., see Ware, 1986); each type of firms has different objective functions though it is unclear as to how an incumbent government school would respond to the entry of a private school in the locality. Along these lines, we would like to examine whether the presence of private schools have any impact on the pass rates of the local state school(s). If not, we could conclude that the element of competition seems to be absent among the government schools in our sample, who tend to enjoy a secure source of funding, independent of school performance. Secondly, we examine the effect of presence of a private school on the overall pass rates in the village and envisage a positive effect. The latter can be attributable to the presence of better-off households and more public infrastructure in the villages with a private school.

Considering class V pass rate as the indicator of school quality, we determine (a)

average village-level class V pass rates Q_{vs} of both state and private schools in the village v located in state s and (b) class V pass rates Q_{gvs} of the state school(s) in the village v located in state s. [18]

$$Q_{vs} = \theta_1 P_{vs} + \theta_2 \rho_s + \varepsilon_{3vs}$$
$$Q_{gvs} = \eta_1 P_{vs} + \eta_2 \rho_s + \varepsilon_{4vs} \qquad (3)$$

where P_{vs} is a binary variable indicating the presence of a private school in the village while ρ_s denotes the state per capita income. Note however that the presence of a private school in a village v in state s is a choice variable that we determined in section 4.1 and thus simple OLS estimates of (3) are going to be biased. So we first generate the predicted value of P_{vs} using the probit estimates shown in Table 5 and use this predicted value of P_{vs} as a possible instrument in a 2SLS estimate. We also compare the 2SLS estimates with the corresponding OLS estimates of (θ_1, θ_2) and (η_1, η_2). Note however that our ability to generate the best possible instruments is limited by the fact that this analysis is based on single (and not repeated) cross-section data. It is thus possible that the difference in the 2SLS and the corresponding OLS estimates could reflect the measurement errors in the instruments used. It can however be argued here that if private schools tend to locate in places where unobserved parents' tastes/preferences for education are higher, we are likely to overestimate the impact of private schools on educational outcomes; in this case the estimates obtained would be an upper bound of the true effect. Similarly, if competition from private schools causes public schools to increase their quality, the impact of the presence of private schools on public school

[18] We also tried to use pupil-teacher ratio PTR as an alternative indicator of school quality. Some may however argue that PTR is not a good indicator of school quality in this context as presence of both private and state schools in a village would naturally be accompanied by lower PTR relative to villages with one type of school. Thus we consider class V pass rates to be a more appropriate indicator of school quality.

quality is likely to be overestimated (see further discussion in section 4.3).

4. Empirical Findings

This section describes and analyses the estimates of entry/location choice of private schools and households (section 4.1), household demand for private schools (section 4.2) and also the effects of school choice on school quality (section 4.3).

4.1. Location choice of private schools and private households

Fixed effects probit maximum likelihood estimates of the presence of private school equation (1) are shown in Table 5. We have summarised the results from two specifications (1) and (2). While specification (1) includes only the village-level factors, specification (2) is the complete model that includes all relevant factors identified in section 3.1. Given that the likelihood ratio statistic is significantly higher for specification (2), the rest of the discussion is couched in terms of the estimates of specification (2).

There is evidence that the likelihood of private school presence in a village is significantly influenced by the characteristics of local state-run schools.[19] In particular, presence of both the head and other teachers seem to matter a lot– in fact, the likelihood of private school presence is significantly higher if the attendance of head and other teachers in the local government school is lower. However, school infrastructural facilities or multigrade teaching does not turn out to be important in our sample. This

[19] We also tried to include the number of existing state schools in each village though it was never significant in any specification; this is perhaps because of the lack of variation in the variable across the sample villages.

provides some support to the hypothesis that private school is more likely to be present in the village with poorly functioning state-run schools as has been noted by Muralidharan and Kremer (2006).

State characteristics also play an important role in the location of private schools in a village. In particular, the likelihood of private school presence is significantly lower in states with higher per capita income, something, which was also observed by Muralidharan and Kremer (2006). This last result may require further explanation. In an attempt to explore this, we compare the average village, school and other household characteristics among the sample states (see Table 3). Clearly both enrolment rates and pupil-teacher ratios (PTR) are significantly lower in the more affluent state HP compared to the other four PROBE states. Prevalence rate of private schools in HP is less than half than that in UP[20] and it continued to be so in 2003. Thus one possible explanation of the inverse relationship between state prosperity and rise of private schools could be that the more prosperous states tend to have less pressure on the state-run schools (as reflected in lower enrolment and PTR for example) so that these state schools tend to perform better than their counterparts in the worse off (and more populous) states. The latter could be driven by both demand (e.g., related to lower fertility rates) and/or supply side (e.g., allocation of more teachers/resources to the state schools in better off states) factors.

More interestingly, these results highlight the importance of public infrastructure (predicted) on private school presence in the sample villages, something that has never been examined in the Indian context. There is suggestion that private schools are more

[20] Note however that the case of Rajasthan is rather different where total enrolment and PTR is comparable to the other worse performing states though the % of villages with a private school is more comparable to the more affluent state HP. It however follows from the Table that private school entry in Rajasthan had a late start, though it came in line with those in Bihar and UP in 2003.

likely to be present in villages closer to pucca road and district head quarter. In addition, village-development index (comprised of the village's access to electricity, piped water, phone and post-office) plays a significant role – more developed villages with access to these infrastructural facilities are significantly more likely to have a private school; the latter is likely to be compatible with a higher rate of return on private investment, which in turn provides some support to the public capital hypothesis.

To summarise, there is evidence that the allocation of private capital by private schools may follow the access to public infrastructure in India. In section 4.3., we shall further examine if this location choice of private school is associated with a positive productivity effect, as emphasized in the recent literature on 'public capital hypothesis'.

4.2. Household demand for private schools

Table 6 summarises the estimates of the likelihood that parents choose to send a child to a private school in the village. We show three sets of estimates here: column (1) shows the uncorrected univariate probit estimates of the likelihood that parents send a child to a private school; these estimates are however likely to be biased as it does not correct for the probability of ever-enrolment. Columns (2) and (3) respectively show the simultaneous and bivariate (sequential) probit estimates of parental choice of private schools; while the multivariate probit estimates jointly determine the possibility of ever-enrolment and choice of private school, bivariate probit estimates correct for the selectivity bias that the child has been ever-enrolled.[21] Note, however, that correlation

[21] Similar estimates are obtained even when we replace parental characteristics by their predicted values obtained from the first stage estimates shown in Table 7. Only difference is that t-statistics for the parental characteristics are lower in case of instrumented estimates while the signs of the coefficients remain unchanged.

coefficients in both simultaneous and bivariate probit models are significant although the absolute value of log-likelihood is higher for the simultaneous probit. Moreover, there are evidence of some mis-specification in the bivariate estimates as the estimates of pupil-teacher ratio and number of infrastructural facilities in the state school appear to be counter-intuitive; the latter may be a result of treating enrolment and private school choice as sequential rather than simultaneous.

Therefore, our discussion in this subsection is couched in terms of the simultaneous probit estimates shown in column (2) of parental choice of private schools. Note that characteristics of the individual child or its siblings are not very important while the characteristics of the household, local state schools and village infrastructure are very significant. First, there is suggestion that the likelihood is significantly higher for children born to more educated mother and also for those belonging to non-Muslim households.[22] Father's education is however insignificant in specification (2). In a sense, parental education and caste/religion in India can be taken to be good measures of wealth; there is thus suggestion that children from better off families[23] are more likely to attend fee-paying private schools, which is naturally to be expected. Secondly, instrument of village composite infrastructural facilities is positive and highly significant, thus indicating a higher demand for private schools from households residing in more developed villages with access to more infrastructural facilities. As argued earlier, the latter could be taken as a measure of wealth effect. Finally, ceteris paribus, these estimates corroborate the estimates presented in section 4.1 in that the household demand

[22] In fact Table 4 suggests that there is no low caste or Muslim households who send their children to private school.

[23] We also tried including household landholding as an additional explanatory variable though it was never significant in any specification. That is why we dropped it from the final specification. Note however that we do not observe household income or expenditure.

for private schools is significantly related to the poor quality of local government schools. In particular, parents are more likely to send their children to private schools when pupil-teacher ratio is higher and teacher's attendance rate is lower in the local state schools, thus indirectly revealing their preferences for better schooling services provided by private schools.

4.3. Effect of school choice on school quality

Finally we examine the effect of presence of private schools and thereby greater school choice (resulting from the coexistence of both private and state schools in the village) on school quality. As indicated in section 3, this turns out to be a complex exercise as the characteristics of the village and the households get intertwined (via endogenous location choice), which in turn affects the quality of schooling. First, private schools tend to enter the more developed villages with access to pucca road, piped water, electricity, phone and post office (i.e., an aspect of endogenous location choice of private schools; also see discussion in section 4.1). Thus instead of using the observed variable whether there is a private school, we generate a predicted value of this variable using specification (2) shown in Table 5.

Finally, considering class V pass rates as possible indices of primary school quality in the village we obtain estimates of (a) state-school pass rates and (b) average pass-rates of the village as a whole (including both state and private school pass rates). In each case, we show both ols and 2SLS estimates; note that the 2SLS estimates are derived by using the predicted value of the presence of a private school in the village (derived by using estimates of specification (2) in Table 5) as an instrument for the

presence of private school. In each case, we also use the predicted village infrastructural index (derived from estimates shown in the Appendix Table A1). Both sets of estimates are summarized in Table 7.

While uncorrected OLS estimates of pass rates are shown in columns (1) and (3) respectively for these two indices of school quality, 2SLS estimates are shown in columns (2) and (4) of Table 7. The difference of 2SLS estimates from the uncorrected OLS estimates is noteworthy; while 2SLS estimates shows the bias corrected estimates, a part of the difference between 2SLS and OLS may also be attributed to the measurement error arising from the choice of instruments. Our discussion here is couched in terms of the 2SLS estimates shown in columns (2) and (4). Note that the presence of private school exerts a positive and significant effect on village class V pass rates and the effect is more pronounced when we consider the 2SLS estimates. Presence of private school however fails to have a significant impact on government school pass rates irrespective of whether we consider OLS or 2SLS methods. The latter appears to highlight the absence of competitive environment in the schooling system in India where there is a secure source of funding for government schools irrespective of their performance (see discussion in section 3.3).

Taken together, there is suggestion from the 2SLS estimates that school quality indices are significantly higher in the villages with a private school. We argue that this result is driven by initial distribution of land and ethnic heterogeneity in the Indian villages so that villages with more unequal landholding not only have better access to more infrastructural facilities, for given levels of ethnic fractionalisation, but also tend to have a private school. It also follows that these better off villages with private schools

tend to have higher pass rates, thus highlighting the role of public infrastructure on private productivity. There is however no evidence that presence of private schools in a village can boost the pass rates in government schools, thus questioning the strategic response of government schools to presence of private schools in our sample. A further implication of this result is that remote villages (away from the district head quarter and/or pucca road), however, fail to get the attention of public authority and/or private providers, especially if they do not have any influential elite.

One however needs to interpret these results somewhat cautiously because infrastructure development itself may be correlated to unobservable determinants of school quality through many possible factors including the presence of supplemental private funding, returns to education, peer effects, etc. It is however rather difficult, if not impossible, to evaluate the effect of infrastructure development without repeated cross-sections or panel data. We hope that future research will address this issue.

5. Concluding Comments

The market for schooling is changing in India's emerging economy, as public providers are increasingly being challenged by a growing number of private providers. However our knowledge about the supply behaviour of private providers of schooling as well as its effect on quality of schooling in India remains virtually unexplored. The present paper is a first attempt to bridge this gap of the literature.

Results from the PROBE villages in India offer some interesting insights and highlight the role of village-level public infrastructure (as reflected in the access to

concrete road, district head quarter, electricity, piped water, phone and post office), among other things, on school quality that remains rather unexplored. There is evidence that private schools are more likely to enter the villages with more infrastructural facilities and poor quality of public schools. Secondly, other things remaining unchanged, the likelihood of household choice of private school is higher, if the village is more developed and if the teacher's attendance rate in local state school is poor. Finally, average school pass rates are generally higher in villages with a private school; government school pass rates however remain unaffected by the presence of a private school in a village.

Given the possible endogeneity of infrastructural development in a village, we generate an instrument using distribution of landholding and ethnic fractionalisation index in the village. Accordingly, we argue that more unequal villages tend to have more infrastructural facilities, for given level of ethnic fractionalisation. We cannot however control for the possible correlation between infrastructure development and some unobservable determinants of school quality indices over time as the PROBE data is essentially single cross-section data. We however envisage that we are likely to overestimate the impact of private schools on pass rates, as private schools tend to be present in places where unobserved parents' preferences for education are higher (while school competition effect remains insignificant). Thus the estimates of pass rates are likely to be an upper bound of the true estimates. This is an issue that remains rather unexplored in the development literature and we hope that future research will generate further wisdom in this respect.

References

Aschauer, D. (1989). 'Is Public Expenditure Productive?' *Journal of Monetary Economics,* 23, pp. 177-203.

Aschauer, D. (1997) 'Output and Employment Effects of Public Capital', working paper, Jerome Levy Economic Institute.

Barro, R. (1990). 'Government Spending in A Simple Model of Endogenous Growth', Journal of Political Economy, 98, pp. S103-25.

Bashir, S. (1994) 'Public versus Private in Primary Education: Comparison of School Effectiveness and Costs in Tamil Nadu', PhD Dissertation, London School of Economics.

Bayer, P., F. Ferreira and R. McMillan. 2003. A Unified Framework for Measuring Preferences for Schools and Neighborhoods, mimeo, University of Toronto.

Bedi, A.S. and A. Garg. (2000) 'The Effectiveness of Private versus Public Schools: The Case of Indonesia', *Journal of Development Economics* 61 pp. 463-94.

Behrman,J.R., and Knowles,J.C. (1999) 'Household Income and Child Schooling in Vietnam', *The World Bank Economic Review*, Vol.13(2), pp.211-56.

Bennett, J. and E. Iossa. (2006) 'Building and managing facilities for public services,' *Journal of Public Economics*.

Black. S. 1999. 'Do Better Schools Matter? Parental Valuation of Elementary Education', *Quarterly Journal of Economics*.

Brown, D. 1979. 'The Location Decision of the Firm: An Overview of Theory and Evidence' *Papers in Regional Science*, 43(1), 23-39

Butcher C, Case A (1994) 'The Effect of Sibling Sex Composition on Women's Education and Earnings, *Quarterly Journal of Economics* 109(3): 531-63.

Census of India. (2001) 'Data Highlights: Migration Tables D1, D2 and D3', Office of the Registrar General, India, Government of India.
www.censusindia.net/results/dseries/data_highlights_D1D2D3.pdf.

Chaudhury, N., J. Hammer, M. Kremer, K. Muralidharan and H. Rogers. (2005) 'Missing in Action: Teachers and Health Workers Absence in Developing Countries', *Journal of Economic Perspectives*.

De, A., M. Majumdar, M. Samson, and C. Noronha. (2000) 'Role of Private Schools in Basic Education' National Institute of Education Planning and Administration and Ministry of Human Resource Development, Government of India: Year 2000 Assessment: Education for All.

De Fraja, Giovanni and F. Delbono. (1990) 'Game Theoretic Models of Mixed Oligopoly', *Journal of Economic Surveys* 4(1).

Drèze, Jean and Geeta Kingdon. (2001) "School Participation in Rural India", *Review of Development Economics*, 5, No. 1: 1-33.

Epple, D. and R. Romano. (1998) 'Competition between Private and Public Schools, Vouchers and Peer Group Effects', *American Economic Review* 88(1) pp. 585-610.

Hansen, N. (1965). 'Unbalanced Growth and Regional Development', *Western Economic Journal* 4, pp. 3-14.

Hoxby, C. (1994) 'Do Private Schools Provide Competition for Public Schools?' NBER working paper No. 4978d.

Kingdon, Geeta. (1996) "The Quality and Efficiency of Public and Private Schools: A Case Study of Urban India", *Oxford Bulletin of Economics and Statistics*, 58, No.1: 55-80.

Kingdon, G. 1998. 'Does the Labour Market Explain Lower Female Schooling in India?', *Journal of Development Studies*, 35(1), pp. 39-65.

Martin, P. and A. Rogers. (1995) Industrial Location and Public Infrastructure', *Journal of International Economics* 39, pp. 335-351.

Munshi, K. and M. Rosenzweig. (2006) 'Traditional Institutions Meet the Modern World: Caste, Gender and Schooling Choice in a Globalizing Economy', *American Economic Review*, pp. 1225-1252.

Muralidharan, K. and M. Kremer. (2006) 'Public and Private Schools in Rural India', mimeo Harvard University.

Newhouse, D. and K. Beegle. (2005) 'The Effect of School Type on Academic Achievement-Evidence from Indonesia', *Journal of Human Resources*.

Pal, S. (2004). 'How Much of the Gender Difference in Child School Enrolment Can Be Explained? Evidence from Rural India', *Bulletin of Economic Research* 56(2), pp. 133-158.

Pal, S. and S. Ghosh. (2007) 'Elite Dominance and Underinvestment in Mass Education: An Analysis of the Disparity in Social Development of the Indian States 1960-92', IZA discussion paper no. 2852, University of Bonn, Germany.

PROBE Team. (1999) '*Public Report on Basic Education in India*', Oxford University Press.

Reinikka, R. and J. Svensson. (2002) 'Coping with Poor Public Capital', *Journal of Development Economics*, 69, pp. 51-69.

Schmenner, R. 1978. 'The Manufacturing Location Decision: Evidence from Cincinnati and New England', Economic Development Research Report, Graduate School of Business, Harvard University, Cambridge, Massaschusetts.

Vickerman, R.W. 1990. '*Infrastructure and Regional Development'*, Pion: London.

Ware, J. (1986) 'A Model of Public Enterprise with Entry', *Canadian Journal of Economics*, pp. 642-55.

Tables

Table 1. Distribution of state and private schools across sample states

	% of villages			
	(1) PROBE school survey		(2) PROBE sample villages	
State	State schools only	Both state and private schools	State schools only	Both state and private schools
UP	75	20	73	32
Bihar	80	13	79	17
Himachal Pradesh	89	11	80	20
Rajasthan	86	11	86	14
MP	92	8	95	5

Note: There are 290 schools in the PROBE school survey while there are 170 schools in 123 sample villages from which child/household information was also collected in the PROBE survey.

Table 2. An Inter-state comparison of selected characteristics

Averages	UP	Bihar	MP	Rajasthan	HP
Enrolment	145	157	127	146	93
Pupil-Teacher Ratio	53	49	49	49	26
% of never-enrolled children	34	36	38	37	24
Pass rate (%)	89	83	61	90	85
Distance from pucca road (km)	1.94	3.87	5.6	3.7	2.3
Low caste households(%)	55	76	80	47	63
Muslim households(%)	17	11	1	6	3
Per capita sdp, 1996	6713	4231	7571	8974	10583
Total fertility rate, 1991	5.1	4.4	4.6	4.6	3.1
Birth rate, 1990-92 (per 1000)	35.8	31.9	35.7	34.4	27.9
% of villages with no school, 2002 [3]	26	15	14	19	5.2
% of villages with private schools [3]	26.1	1	18.2	26.2	5.8
% of villages with a private schools, 2003 [2]	57	54	23	52	15

Note: Most information are gathered from PROBE survey (1999) unless otherwise stated. PROBE information relates to the schools and households in the sample villages only. [1] This is a composite index comprising of the village's access to piped water, electricity, phone and post-office. [2] Source: AISES 7th round 2002-03. [2] Source: Muralidharan and Kremer (2006); Note that AISES data focuses on recognised schools only while PROBE and Muralidharan and Kremer consider both recognised and unrecognised schools.

Table 3. Comparison of private and state schools

School characteristics	Private school	State school	T-statistics (equal variances are not assumed) [1]
Teacher does multi-grade teaching (%)	72	73	-
No of infrastructural facilities [1]	5.8	4.8	3.245**
Principal absent (%)	18	33	-2.411*
Teacher's attendance rate (%)	81	81	
Female teachers (%)	23	21	-
Hardcore punisher (%)	89	84	-
Teacher's education (years)	13.5	13	-
Teacher's age (years)	28	38	-5.099**
Class 1 teacher lives in the same village (%)	69	27	5.533**
Teachers with pre-service training (%)	18	67	-7.437**
Teachers with in-service training (%)	11	54	-7.288**
Enrolment	108	144	-2.439*
Pupil teacher ratio	24.5	47.6	-9.228**
Pass rate in class V board exam (%)	99.2	94.3	4.759**

Note: T-test is shown only when the statistic is significant. '*' denotes significance at 5% while '**' denotes that at 1% or lower level. T-statistic is not shown if the difference is insignificant. [1] It is a composite index of functional school infrastructural facilities that includes access to drinking water, toilet, electricity, fan, playground, blackboard etc.

Table 4. Comparison of villages with and without private schools

Average village characteristics	Villages with a private school	Villages without a private school	T-statistic for mean comparison
Pupil per teacher	48.38	44.89	0.830
Class V pass rates	92.3	80.8	2.547*
Population > 1000 (%)	50	21	14.446**
Male education (years)	6.4971	5.0804	15.857**
Female education (years)	2.2655	1.1577	15.533**
Low caste households (%)	58	63	-4.928 **
Muslim households (%)	5	11	-10.155 **
Access to piped water (%)	33	15	9.776 **
Access to phone (%)	52	20	16.079**
Access to Post Office (%)	47	24	11.850 **
Average distance from pucca road (km)	1.6	3.6	-20.663 **
Average distance from district HQ (km)	3.2	8.5	-30.105**
Composite village infrastructural index	0.69	-0.02	17.067**
Mean landholding	3.8	3.1	6.674**
SD of landholding	3.8	3.3	4.051**
Ethnic fractionalisation	0.62	0.73	-12.698**

Note: '*' denotes significance at 5% while '**' denotes that at 1% or lower level. These statistics are based on the information obtained from the sample villages only. There were 1322 households and 170 schools in 123 sample villages. Composite infrastructural index is the first principal component of the village's access to piped water, electricity, phone and post office. Index of ethnic fractionalisation is given by $1-\sum p^2_i$, where p_i is the population proportion of upper caste Hindu, SC, ST and Muslim living in each village.

Table 5. Probit estimates of location choice of a private school

	(1) Coefficient	T-stat	(2) Coefficient	T-stat
Principal absent			0.43	4.131**
Teacher's attendance			-0.43	4.119**
Village distance from road	-0.09	8.909**	-0.11	10.227
Village distance from district HQ	-0.11	15.846**	-0.12	15.736**
Village infrastructural index (predicted)	1.6	6.456**	1.33	5.146**
State fixed effects	Yes	Yes	Yes	Yes
Log-L	-1603.077		-1618.697	
Chi-sq	662.4286**		631.1889	
N	123		123	

Note: Village infrastructural index is a composite index of the village's access to piped water, electricity, phone and post office. We use predicted value of the variable using estimates presented in Table A1. '*' denotes significance at 10% while '**' denotes that at 1% or lower level. Number in the parentheses shows the corresponding marginal effects.

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Table 6. Estimates of household demand for private schools

	(1) Univariate probit		(2) Simultaneous probit [1]		(3) Bivariate probit [1]	
Variables	Coefficient	T-statistic	Coefficient	T-statistic	Coefficient	T-statistic
Child is a male	-0.30	3.656**	0.03	0.357	-0.30	3.490**
Child> 10 years	-0.04	0.822	-0.04	0.813	-0.07	1.438
Proportion of male <18 years	0.004	1.091	0.003	0.032	0.004	0.066
Proportion of female < 18 years	-0.52	2.360*	0.37	1.452	-0.51	2.273*
Male*proportion of young female <18 yrs	0.51	2.351*	-0.37	1.460	0.51	2.265*
Mother's education	0.05	6.843**	0.07	8.470**	0.05	6.648**
Father's education	-0.001	1.406	-0.006	1.602	-0.001	1.305
Muslim	-0.32	3.332	-0.35	3.556**	-0.32	3.182**
Pupil teacher ratio in the state school	-0.01	7.672**	0.01	3.735**	-0.01	6.932**
% of teacher present in the state school	0.12	5.764**	0.73	6.368**	0.12	1.613
No. of infrastructural facilities in the state school	-0.10	4.963**	-0.01	0.379	-0.10	4.555**
Village infrastructural development (predicted)	1.92	8.248**	2.0	7.680	1.91	7.688**
State fixed effects	Yes		Yes		Yes	
RHO(1,2)	-		0.04	1.720*	0.05	1.802*
Log L	-1857.735		-4422.311		-4459.689	
LR	153.1138					
N	4461		4461		4461	

Note: '*' denotes significance at 10% while '**' denotes that at 1% or lower level.
[1] Simultaneous and bivariate probit estimates correct for the possibility of ever-enrolment.

Table7. Effects of private school presence on class V pass rates

	Govt. school pass rates		**Total pass rates (Govt & private school)**	
Variables	**(1) OLS**	**(2) 2SLS**	**(3) OLS**	**(4) 2SLS**
	Coefficient (T-statistics)	Coefficient (T-statistics)	Coefficient (T-statistics)	Coefficient (T-statistics)
Presence of private school	0.09 (1.412)	0.56 (1.363)	0.14 (9.070)**	0.22 (3.095)**
Intercept	Yes	Yes	Yes	Yes
State prosperity	Yes	Yes	Yes	Yes
R^2	0.44	0.28	0.23	0.13
F-stat	4.63**	5.59**	46.82**	13.49**
N	123	123	123	123

Note: '*' denotes significance at 10% while '**' denotes that at 1% or lower level. 2SLS estimates use an instrument for the presence of private school, which is the predicted value of private school presence derived from the probit estimates shown in Table 5.

Appendix

Table A1. Estimates of village infrastructural development index

	Coefficient	T-stat
Ethnic heterogeneity	-0.07	4.752**
Mean landholding	-0.03	2.843**
SD of landholding	-0.14	1.179
Ethnic hety*SD of land	0.11	6.262**
State fixed effects	Yes	Yes
R^2	0.18	
F-stat	20.00**	
N	123	