Education Consumption in an Emerging Market[*]

Sachin Sancheti
135 Prospect St, PO Box 208200
New Haven, CT 06520
Email: sachin.sancheti@yale.edu
Phone: (203) 508-2872
Fax: (203) 432-3003

K. Sudhir
135 Prospect St, PO Box 208200
New Haven, CT 06520
Email: k.sudhir@yale.edu
Phone: (203) 432-3289
Fax: (203) 432-3003

April 2009

[*] We thank participants at the China India Consumer Insights Conference at Yale and the Doctoral Research Workshop at Yale SOM for their comments.

Abstract

Private schools serve a significant section of the Indian student population in the K-12 market. This share is likely to increase with the country's growth as households-both rich and poor clamor for quality education. This paper seeks to understand the determinants of schooling (public and private) in rural India. We present and estimate a discrete-continuous model of household school choice and educational spending decisions. Our estimates give insights on (1) households and individual determinants on schooling demand in rural India; (2) the tradeoff off between marketing mix variables such as fees and transportation facilities; and (3) how private-public partnerships through government subsidies for private schools can expand category consumption by increasing total school enrolment.

Keywords: Emerging market, education consumption, discrete-continuous choice, India, rural markets.

1. Introduction

Education is a booming business opportunity in India. Of the 361 million children of school going age in India, 219 million attend schools. Of these 219 million, 60% attend government schools and 40% attend private schools. Overall, 40% of students of school going age, i.e., about 141 million, do not attend school. Thus private schools have a considerable opportunity not merely to steal market share from government schools, but also to expand the market. According to estimates from CLSA, an Asia Pacific investment group, the market for education in India is estimated at $40b (CLSA, 2008), with close to $20 billion for K-12 school education. With rising incomes and demand for education, the future potential is estimated to be even greater at $60 billion. In response to this opportunity and motivated by social considerations, a number of budget school chains serving the lower socio economic strata have entered the Indian schooling market in recent years.[1]

In developed countries, private schools typically tend to evoke an image of elitism, where they skim off the cream of society's children to provide them a higher quality of education, thus perpetrating inequality. Such an image is far removed from reality in the Indian context. Though, the Indian government has made universal education a priority under the aegis of 'Sarva Shiksha Abhiyan' (meaning 'Education for All' in Hindi) and provides free education to children between the ages of 6 and 14, a large number of children of school-going age do not attend school and among those that do, the private sector captures over 40% share of students enrolled. Private schooling is thus not confined to rich, urban communities in India.

Private school enrolment in rural India is about 27.3% of all school enrolment (Pratham 2008), in contrast to 11% of all school enrolments in the United States (Current Population Survey, 2005). Figure 1 shows the proportion of total school going age children (enrolled and not enrolled) across all states of rural India. Even in Uttar Pradesh, India's most populous (190 million people), but one of the poorest states, the proportion of rural children enrolled in private schools is large (Figure 2). But private schooling is not confined to high income households in these poorer states. Figure 3 shows the

[1] Examples of such chains include SKS-Career Launcher Academy in Andhra Pradesh, with annual fees of $45 and Vidya Prabhat Schools in Uttar Pradesh with annual fees of $180.

proportion of children going to private schools from different income groups in two of the poorest Indian states: Uttar Pradesh and Bihar. It is clear that all income groups send children to private schools, though higher income households are more likely to send their children to private schools.[2]

Why do low income households send their children to higher priced private schools when the free government alternative is available? Government schools though free, do not offer an adequate education because teachers are not accountable. Many teachers do not attend school regularly, and even when they attend do not teach. Kremer, et al. (2005), in a study of Indian primary schools find that private school teachers are 8 percentage points less likely to be absent than government school teachers in the same village. Government schools also typically introduce English language at a later stage, a key attribute that parents are looking for to make their children successful in the globalizing market place. In sum, the perceived (and by most accounts objective) quality of government schools is lower. In response, an army of entrepreneurs and companies are addressing the vacuum left by an ineffective state school system with private schools.

Gurcharan Das, the Chairman of SKF Microfinance a micro-credit lending organization for poor households, which recently introduced a chain of budget schools in the southern state of Andhra Pradesh in India says it succinctly: *"The middle class abandoned state education a generation ago. Now the poor in India are doing the same... Indians are finding a new model, they don't sit around. If government schools fail and teachers don't show up, entrepreneurs start schools for the poor in the slums and children get educated. I think some real fortunes will be made in education in the years to come, partly because the state has not succeeded."*[3] Rather than the traditional view that private schools tend to be elitist and serve to perpetuate inequality by providing a small selective set of students a higher quality of education, the ground reality in India is that private schools may be a democratizing force in education, making access to quality education more equal across the poorer sections of society. In response, even the government has become more open to the involvement of the private sector in education,

[2] Since income information is not typically available, we classify households by their per-capita expenditures.
[3] The Guardian Weekly, Dec 11, 2008.

considering private-public partnerships and allowing 100% foreign direct investments in education.

In this article we present a model of school choice to better understand school enrolment decisions of households in India. Households face three choices: whether to enroll children in a private or government school or not at all. Private schools have higher fees than government schools but can potentially lead to better outcomes due to more consistent and/or higher quality of instruction. Households need to compare the positive benefits of schooling against the opportunity cost of have the child either work outside the home or engage in home production. Further they face a travel cost that depends on the distance to the school. These benefits and costs of course vary with individual characteristics such as age, gender etc.

The value of schooling itself, however, depends on other educational expenditures made by the household that affect efficacy of education. For example, if a household enrolls the child in a private school but spends very little on books and stationery, the value of the school would be relatively low. Hence, the choice of whether and which school to enroll would also depend on how much related expenditure the household is willing to incur to make schooling worthwhile. We, therefore, model both the enrolment choice and educational spending simultaneously using a discrete-continuous demand framework (Hanemann 1984), taking into account budget constraints that households face.

We estimate the model using rural household data from Survey of Living Conditions, conducted by the World Bank in 1997-1998 in two states of India. These states in the northern part of India, called Uttar Pradesh and Bihar, are counted among the more backward states and along with Rajasthan and Madhya Pradesh are collectively called ‘BIMARU’ (meaning “sick” in Hindi) states. We supplement the household survey data with school supply data from District Information System for Education (DISE) collected by Government of India. Both these publicly available datasets are new to the marketing literature and unique in that they contain rich information on household demographic and behavioral variables, and disaggregate information on the number of schools. Most publicly available datasets from India do not have information on supply side variables at a disaggregate level. The DISE dataset, on the other hand, provides us with the number of government and private schools at the block level.[4]

One challenge in estimating the value of private schooling using a model of household schooling decisions is that private school availability and hence distance to school may be endogenous. Since the decision to open and operate private schools is likely correlated with demand characteristics unobserved to researchers, private school supply is likely correlated with the demand side unobservable. Not accounting for this endogeneity can lead to biased inference on the household utility parameters. For example, if there is an unobservable (to the econometrician) factor like education awareness that increases demand for private schools and private schools use this information in their decision to open schools in a particular market, the sensitivity of households to the availability of private schools will be overestimated. Fees are also potentially endogenous. In order to correct for endogeneity, we use a LIML approach, where we jointly estimate the household choice model with two equations for distance and fees regressed against instruments that are potentially uncorrelated with the demand shocks.

We use the model estimates to obtain three key sets of insights: First, the estimated model gives us descriptive insights on how household and individual specific characteristics affect the benefits and costs of schooling and how these affect enrolment and spending decisions. We gain insight into the differential effects of the role of demographic variables such as gender and age, variables under the firm's control such as fees, distance to school, and other household specific characteristics such as the availability of transportation etc. Second, we are able to assess the relative effectiveness of alternative marketing mix variables such as fees and transportation on enrolment decision and its relative impact on enrolment and schooling decisions. We are able to decompose how private school's marketing mix decisions lead to share stealing from government schools as opposed to increasing category consumption by expanding school

[4] A block is an administrative unit smaller than a district, but comprises several villages. A median block in India is about 250 square km, which would be the equivalent of four contiguous towns in Connecticut: New Haven, Woodbridge, Orange and Hamden. These four towns have roughly the population of about 200,000 people, while in our rural Indian market there are that many school-going children in this area. Despite the substantially higher population density, such a region would be considered urban or sub-urban in the United States, but rural in India.

enrolment. Finally, we perform counterfactual simulations based on a free entry supply model to evaluate the number of private schools that can be supported at any given level of monthly cost of operation. This analysis facilitates an analysis of the level of subsidy that the government may need to provide private schools if it seeks to increase enrolment by encouraging private sector participation in the education sector.

We now contrast this paper with existing research on the schooling market. Research in economics on schooling has focused on three main themes. The first theme is returns to schooling (See Card, 2001 and Belzil, 2007 for surveys of articles that estimate returns to schooling). Estimating returns to schooling is difficult due to the presence of unobserved ability that can lead to selection effects. Much of the emphasis in this literature, therefore, is on finding solutions to the econometric issues involved in measuring true returns to schooling.

A second stream of research tries to understand the impact of greater school choice and school competition on school performance and student outcomes. Epple, et al. (1998) present a general equilibrium theoretical model of competition between private and public schools where schools are sorted based on their students' ability and income. Bayer and McMillan (2005) decompose the overall effect of school choice on school quality into the effect of school choice on school competition and the effect of school competition on school quality.

A third stream of research looks at the household schooling decisions in developing countries. Glewwe and Jacoby (2004) shows the presence of wealth effects in demand for education, and Edmonds, et al. (2007) shows the adverse impact of macroeconomic policies like trade liberalization on enrollment in schools. Foster and Rosenzweig (1996) find that rapid technical progress increases returns to education and induces investment in schooling in rural India. Chaudhary, et al. (2006) studies the determinants of child schooling, risk and gender in Ethiopia. They find strong bias against investments in female education in rural areas, an effect that is exacerbated in the presence of income shocks. Kruger, et al. (2007) disentangles the effect of temporary and permanent increase in income on child schooling in Brazil. The find that a temporary increase in economic opportunity for the household increases child labor but a permanent increase in income decreases it. While these papers have investigated household schooling decisions, they have not investigated the demand for and value of private schooling, relative to government schooling-- the key focus of this paper and a primary area of interest to marketers, businesses and policy makers in India who seek to evaluate the role of the private sector in school enrolment and educational outcomes. The closest paper to ours that looks at the substantive phenomenon of private schooling in India is Muralidharan and Kremer (2007). However, it does not study the determinants of demand for private education, but presents survey results on differences between private and government schools.

Our research also contributes more broadly to the understanding of consumer markets in emerging economies. Emerging economies like China and India have been objects of much interest lately due to their rapid economic growth. These consumer markets appear promising and the institutional and market characteristics of these markets lead to potential differences in modeling choices and substantive customer insights. For example, as we have highlighted in the case of the education market, private schools are a much bigger phenomena in India than in the United States even among the poor and the motivations for choosing private schools differ from developed countries. We take a first step towards understanding demand issues in a substantive area that is important and unique to an emerging market such as India and hope that this would stimulate further research of import in these emerging markets. Further, apart from its obvious interest for private and scoial entrepreneurs, the paper is of substantive interest to public policy practitioners in emerging markets.

The rest of the paper is organized as follows: Section 2 provides a description of the model and estimation approach. Section 3 explains the data. Section 4 describes the results and Section 5 concludes.

2. Model Setup

2.1 Demand Model

Households are assumed make a discrete choice of whether to send the child to a private school, a government school or to make the child work. Conditional on sending the child to school, private of government, households decide how much to spend on the child's education. Since households make both a discrete choice and a continuous choice, we need to model their behavior in a discrete-continuous framework. We first describe the household utility function.

Households derive utility from food, education and other consumption goods and optimally choose expenditure levels for each of these categories subject to their budget constraint. More specifically, following Hanemann (1984), we assume the following functional form for utility for household *i* in market *j*

$$u_{ij} = c\left(\psi_{ij}^{c} + 1 - \ln c\right) + s\left(\psi_{ij}^{s} + 1 - \ln s\right) + hz - TC_{ij} + \zeta_{ij}$$

Here *c* is the expenditure on food consumption, *s* is the expenditure on education for the child excluding school fees, *z* is the expenditure on other consumables, TC is the cost incurred to travel for education and ζ is everything else that can affect household utility. The parameters ψ^{c} and ψ^{s} affect household's marginal utility from *c* and *s*, and the parameter *h* represents the marginal utility from *z*. This utility function is concave in *c* and *s* but linear in other expenditures *z*. Concavity in *c* and *s* captures the idea of diminishing marginal utility.

We assume that households get utility from expenditure on education. Greater expenditure can lead to better quality of education and more investment in human capital leading to higher utility. We also assume that education affects current utility even though education is typically treated as an investment good. We make this assumption because we do not have panel data on households that prevents us from building a dynamic model. Our model can be thought of as a static approximation to the dynamic problem that households face and the utility from education as the discounted utility that the household get in the future from educating the child. We also abstain from modeling household allocation of resources across children to keep the model tractable and assume that the household solves this optimization problem for the focal child.

Households maximize utility subject to a budget constraint which depends on the discrete choice of the household (private school, government school or work). For the private school alternative, household's problem is

$$\max_{c,s,z} c\left(\psi_{ij}^{c} + 1 - \ln c\right) + s\left(\psi_{ij}^{p} + 1 - \ln s\right) + hz - TC_{ij}^{p} + \zeta_{ij}^{p}$$

s.t. $c + s + z = I_{ij} - F_{j}$

Here I is the income of household, F is the fee charged by the private school and ψ^{p} affects the marginal utility from education spending (for private school). We assume interior solutions for c, s and z since we do not have any observations in the dataset with corner solutions. Therefore the maximization problem becomes

$$\max_{c,s} c\left(\psi_{ij}^{c} + 1 - \ln c\right) + s\left(\psi_{ij}^{s} + 1 - \ln s\right) + h\left(I_{ij} - F_{j} - c - s\right) - TC_{ij}^{p} + \zeta_{ij}^{p}$$

The solution to this maximization problem is

$$c = \exp\left(\psi_{ij}^{c} - h\right)$$

$$\mathrm{s} = \exp\left(\psi_{ij}^{p} - h\right) \qquad \text{….. (1)}$$

Substituting this solution back into the direct utility we get the following indirect utility from private school

$$V_{ij}^{p} = \exp\left(\psi_{ij}^{c} - h\right) + \exp\left(\psi_{ij}^{p} - h\right) + h\left(I_{ij} - F_{j}\right) - TC_{ij}^{p} + \zeta_{ij}^{p} \qquad \text{….. (2)}$$

Similarly, the indirect utility from government school alternative and the work alternative is

$$V_{ij}^{g} = \exp\left(\psi_{ij}^{c} - h\right) + \exp\left(\psi_{ij}^{g} - h\right) + h\left(I_{ij}\right) - TC_{ij}^{g} + \zeta_{ij}^{g} \qquad \text{….. (3)}$$

$$V_{ij}^{w} = \exp\left(\psi_{ij}^{c} - h\right) + h\left(I_{ij} + I_{ij}^{w}\right) + \zeta_{ij}^{w} \qquad \text{….. (4)}$$

Since government schools are free, there is no fee component in the indirect utility from government schools. For the work alternative, the educational spending and travel cost components are zero but there is an additional term added to the household income I_{ij}^{w} – the income from child's work.

We specify ψ^{p}, ψ^{g}, ζ_{ij}^{p}, ζ_{ij}^{g} and ζ_{ij}^{w} as functions of household characteristics (e.g., age of child, household size, parents' education, monthly per capita consumption, land, etc.), to allow for heterogeneity across households, and alternative specific characteristics:

$$\psi_{ij}^{p} = X_{ij}\beta^{p} + \upsilon_{ij}^{p} \quad , \quad \upsilon_{ij}^{p} \sim N\left(0, \sigma_{\upsilon p}^{2}\right)$$

$$\psi_{ij}^{g} = X_{ij}\beta^{g} + \upsilon_{ij}^{g} \quad , \quad \upsilon_{ij}^{g} \sim N\left(0, \sigma_{\upsilon g}^{2}\right)$$

$$\zeta_{ij}^{p} = Y_{ij}\alpha^{p} + \xi_{j}^{p} + \varepsilon_{ij}^{p}$$

$$\zeta_{ij}^{g} = Y_{ij}\alpha^{g} + \xi_{j}^{g} + \varepsilon_{ij}^{g}$$

$$\zeta_{ij}^{w} = \varepsilon_{ij}^{w}$$

Here, υ_{ij}^{p} and υ_{ij}^{g} are individual level random terms in ψ^{p} and ψ^{g}, and ξ_{j}^{p} and ξ_{j}^{g} are unobserved market level random effects. These unobservable market level random effects may not be independent, especially if some markets have greater awareness about education. We let ξ_{j}^{p} and ξ_{j}^{g} be correlated to allow for the possibility that a market may have higher demand for both private and government schooling. Therefore,

$$\begin{bmatrix} \xi_{j}^{g} \\ \xi_{j}^{p} \end{bmatrix} \sim N\left(0, \Sigma_{gp}\right), \quad \Sigma_{gp} = \begin{bmatrix} \sigma_{g}^{2} & \rho_{gp}\sigma_{g}\sigma_{p} \\ \rho_{gp}\sigma_{g}\sigma_{p} & \sigma_{p}^{2} \end{bmatrix}$$

The ε errors are household unobservables and are assumed to be distributed i.i.d Type-I extreme value. We allow some of the components in β and α to be the same across alternatives and some others to be different as appropriate.

We assume that households do not observe the random terms υ_{ij}^{p} and υ_{ij}^{g} when making the schooling decision. These are random shocks to the marginal utility of educational expenditure that are realized only after the discrete decision is made. Households therefore compare expected indirect utilities from various alternatives and choose the one that provides them with the highest value. Since only differences in utilities matter for a discrete choice model, we can cancel out the terms common across alternatives in (2), (3) and (4). The relative expected indirect utilities therefore can be written as

$$E_{\upsilon}V_{ij}^{p} = \exp\left(X_{ij}\beta^{p} + \frac{\sigma_{\upsilon p}^{2}}{2} - h \right) + h\left(-F_{j}\right) - TC_{ij}^{p} + Y_{ij}\alpha^{p} + \xi_{j}^{p} + \varepsilon_{ij}^{p} \qquad \text{….. (5)}$$

$$E_{\upsilon}V_{ij}^{g} = \exp\left(X_{ij}\beta^{g} + \frac{\sigma_{\upsilon g}^{2}}{2} - h \right) - TC_{ij}^{g} + Y_{ij}\alpha^{g} + \xi_{j}^{g} + \varepsilon_{ij}^{g} \qquad \text{…... (6)}$$

$$E_\upsilon V_{ij}^w = h\left(I_{ij}^w\right) + \varepsilon_{ij}^w \qquad \ldots..\ (7)$$

Note that household income gets cancelled as it enters linearly into the utility function and is common across alternatives. Even though we do not model the effect of income structurally as we do not have income data, we allow the base utility from schooling and marginal utility from education spending to be dependent on monthly per capita expenditure (MPCE) of the household, which can be thought of as a proxy for household income. This allows higher MPCE households to derive different utility from education than lower MPCE households.

We also do not observe the actual income of the child, especially for observations where the child goes to school. Therefore, we let child's income be a function of the daily wage rate (*r)* in the market and the age of the child. Equation (7) then can be written as

$$E_\upsilon V_{ij}^w = h\left(\theta_1 r_j + \theta_2 r_j * Age_{ij}\right) + \varepsilon_{ij}^w \qquad \ldots..\ (7')$$

Equations (5), (6) and (7') are used to obtain household level choice probabilities. Since we assumed type-I extreme value errors, probabilities take the familiar analytical logit form. The probability that the household chooses option *k* is given by

$$\text{Prob}_{ij}\left(k\right) = \frac{EV_{ij}^k}{EV_{ij}^p + EV_{ij}^g + EV_{ij}^w}, \text{ where } k \in \left\{p, g, w\right\} \qquad \ldots..\ (8)$$

If the household chooses to send the child to school, the household then decides how much to spend on education. The spending decision given by (1) can be written as

$$\text{s}^{\{\text{p,g}\}} = \exp\left(X_{ij}\beta^{\{p,g\}} + \upsilon_{ij}^{\{p,g\}} - h\right) \qquad \ldots.\ (9)$$

2.2 Cost of Travel

In order to send their children to school, households have to incur travel cost which depends on the distance to the school. This cost may be nonlinear, i.e. marginal cost of travel may not be constant. Therefore, the cost of travel (TC) in household's utility is specified as a quadratic function of distance to allow for nonlinear distance effects. We also allow for separate effects based on the gender of the child to capture the idea that households may perceive the travel costs for female and male children to be different. In addition, we allow the travel cost to depend on the age of the child and household ownership of a vehicle (bicycle, motorcycle or car). Our hypothesis is that older children and households with vehicles would have lower cost of travel.

$$TC_{ij}^{k,l} = q_1^k d_{ij}^{k,l} + q_2^k d_{ij}^{k,l2} + q_3^k d_{ij}^{k,l} \cdot I\left(girl\right) + q_4^k d_{ij}^{k,l} \cdot I\left(Age > 10\right) + q_5^k d_{ij}^{k,l} \cdot I\left(vehicle\right), \quad k \in \{p, g\} \quad \ldots.. (10)$$

Here l is the 'level' of school and d is the distance to school. We classify schools into two categories – grades 1 to 5 as primary schools and grades 6 and above as 'upper' schools. Upper schools comprise both middle schools and secondary schools.[5] The level of school that the household considers for a child depends on the age of the child. For example, for a 14 year old child, the household would consider government and private *upper* schools in the market.

Unfortunately, in our dataset we do not separately observe distances to private and government schools. However, we can construct a distance measure using information on the number of private and government schools in each market. By making an assumption on how these schools are distributed, we can obtain expected distance to the closest school based on the number of schools and the geographic spread of the market. Intuitively, dividing the number of schools by the geographic area gives us the density of schools in the market. This density can be thought to be inversely related to the distance to the closest school, since greater density of schools would imply a greater possibility of having a school close by. There is a substantial literature in plant ecology devoted to obtaining a relationship between plant density and distance between plants. We adapt methods used in that literature (e.g., Cottam and Curtis, 1956) to obtain the relationship between density and distance for schools.[6]

Let λ be the mean density of schools in the market, i.e. the number of schools divided by the area. Assume that schools are randomly distributed over this area such that the probability that a randomly chosen region of unit area will contain n schools is given by the Poisson distribution.

[5] The number of secondary schools in our data is very small, so a separate analysis for secondary schools is not feasible.

[6] While we do not observe distance to private and government school separately in our dataset, we do observe distance to closest school in the village for some observations. The correlation between observed distance and the distance to closest school (private or government) based on our measure is 0.47.

$$P(n) = \frac{\lambda^n e^{-\lambda}}{n!}$$

Consider a circular area of radius *d* with the households at the center. The mean number of schools in this area is $\lambda \pi d^2$. Therefore, under the Poisson distribution assumption, the probability that this region contains *n* schools is given by

$$P(n) = \frac{\left(\lambda \pi d^2\right)^n e^{-\lambda \pi d^2}}{n!}$$

The probability that this area contains no schools is

$$P(0) = e^{-\lambda \pi d^2}$$

and the probability that this area contains at least one school is

$$P(\text{at least } 1) = 1 - P(0) = 1 - e^{-\lambda \pi d^2}$$

Let d^* be the random variable describing the distance to the closest school for the households at the centre of this geographic area. Therefore, the probability that the distance to the closest school is less than *d* is equal to the probability that there is at least one school in the area with radius *d*.

$$P\left(d^* < d\right) = P(\text{at least } 1) = 1 - e^{-\lambda \pi d^2}$$

Differentiating this probability gives the probability density function (pdf) for d^*

$$p\left(d^*\right) = 2\lambda \pi d^* e^{-\lambda \pi d^{*2}}$$

The expected value of d^* can be obtained as

$$E\left(d^*\right) = \int_0^\infty d^* p\left(d^*\right) = \frac{1}{2\sqrt{\lambda}} \qquad \text{….. (11)}$$

Equation (11) gives us the relationship between the expected distance to closest school and the density of schools in the market.[7] This relationship makes intuitive sense, as distance to closest school and school density are expected to be inversely related. We can use Equation (11) to calculate the expected distance to closest private and government

[7] Technically, ∞ is not the correct limit of integration. The upper limit would be a large number but ∞ is an approximation. If we assume that all households reside sufficiently inside the market and not close to the boundary then this approximation is reasonable. The schools can, however, be located close to the boundary.

school at each level (primary and upper) from school densities in each market. This, in turn, helps us calculate the travel cost for each household, given by Equation (10).

2.3 Endogeneity of Private School Supply and Fees

We have so far assumed that availability of private schools in a market and hence distance to private schools, which affects demand, is exogenously determined. However, private schools are run by private entities and many of them could have a profit motive. Even the ones with a non-profit motive would at least want to break-even. Therefore, the supply of private schools in any market could depend on demand for education in that market and correlated with the unobserved market level effects. Estimating the demand model without accounting for the joint dependence between private school supply and demand can lead to biased inference. Similarly, the tuition fee (*F*) charged by private schools could be endogenous if private schools charge higher fees in markets with greater emphasis on education.

In contrast to private schools, the number of government schools is determined by government policy under the Sarva Shiksha Abhiyan or the Education for All program. One of the norms of this program is to have a schooling facility within 1 km of every habitation.[8] Given, this policy it is reasonable to assume the number of government schools in the market is not based on households' propensity to send children to school, but on providing access. We therefore assume that government school supply is exogenous and not correlated with unobserved demand effects.

We use a limited information maximum likelihood approach (for example, see Villas-Boas and Winer, 1999) to solve this endogeneity problem. Population density and government school density in the market are used as instruments for private school supply and average cost of agricultural land in the market is used as an instrument for private school fees. We believe these are good instruments as they are unlikely to be correlated with unobserved demand for education in the market. Therefore, private school density is specified as

$$\ln\left(\lambda_j^{p,l}\right) = \kappa_0^l + \kappa_1^l pop_j^l + \kappa_2^l \lambda_j^{g,l} + \eta_j^l$$

[8] http://www.education.nic.in/ssa/ssa_1.asp#1.0

$$\begin{bmatrix} \xi_j^p \\ \eta_j^l \end{bmatrix} \sim N\left(0, \Sigma^l\right), \quad \Sigma^l = \begin{pmatrix} \sigma_p^2 & \rho_{\eta p}^l \sigma_p \sigma_\eta^l \\ \rho_{\eta p}^l \sigma_p \sigma_\eta^l & \sigma_\eta^{l2} \end{pmatrix}$$

where pop_j^l is the population density of the relevant age groups of level *l*. $\lambda_j^{g,l}$, as mentioned before, is the density of government schools of level *l* in the market.[9]

Similarly the tuition fee (*F*) charged by private schools is specified as,[10]

$$\ln\left(F_j\right) = \chi_0 + \chi_1 \ln\left(\text{Cost of Agricultural Land}_j\right) + \eta_j^F$$

$$\begin{bmatrix} \xi_j^p \\ \eta_j^F \end{bmatrix} \sim N\left(0, \Sigma^F\right), \quad \Sigma^F = \begin{pmatrix} \sigma_p^2 & \rho_{\eta p}^F \sigma_p \sigma_\eta^F \\ \rho_{\eta p}^F \sigma_p \sigma_\eta^F & \sigma_\eta^{F2} \end{pmatrix}$$

2.4 Model Estimation

To estimate the model, we write the likelihood function as a product of four components - (i) household choice probabilities (ii) density of household educational spending conditional on school choice (iii) density of observed private school density (for primary and upper schools) in the market, and (iv) density of private school fee. Household choice probability, density of private school density and private school fee are obtained conditional on the demand side market level unobservables that need to be integrated out. Denoting the probability densities of spending on private and government education *s*, conditional on school choice, by $f^p(\cdot)$ and $f^g(\cdot)$ respectively, the probability density of private school density $\lambda_j^{p,l}$ conditional on ξ_j^p by $g^l(\cdot)$, the probability density of private school fee conditional on ξ_j^p by $\Gamma(\cdot)$ and the joint probability density of unobserved market level random effects ξ_j^p and ξ_j^g by $\phi(\cdot)$ respectively, we can write the likelihood function as

[9] Note that we are specifying the supply side equation in terms of private school density and not distance. Since we are taking log of the private school density, it does not matter if we use density or distance to correct for endogeneity, given the relationship between the two (see eq. 11).

[10] We assume the fee to be the same for both primary and upper schools in a market. This is done for two reasons. First, by splitting schools into primary and upper levels, we are not able to reliably calculate the fee for them separately due to data limitations. Second, we want to correct for the possible endogeneity of *F* in a parsimonious way, keeping the number of parameters to be estimated manageable.

$$\prod_{j=1}^{J}\int\int\prod_{i=1}^{n_j}\text{Prob}_{\text{ij}}\left(k \mid \xi_j^p,\xi_j^g\right)f^k\left(s_{ij}\right)g^{prim}\left(\lambda_j^{p,prim} \mid \xi_j^p\right)g^{upper}\left(\lambda_j^{p,upper} \mid \xi_j^p\right)\Gamma\left(F_j \mid \xi_j^p\right)\phi\left(\xi_j^p,\xi_j^g\right)d\xi_j^p d\xi_j^g$$

where $k \in \{p, g, w\}$ is the option chosen by household *i*, $\text{Prob}_{\text{ij}}\left(k \mid \xi_j^p,\xi_j^g\right)$ is the probability of the chosen option for household *i*, n_j is the number of observations belonging to market *j* and $f^w(\cdot)=1$.[11]

Note that $\text{Prob}_{\text{ij}}\left(k \mid \xi_j^p,\xi_j^g\right)$ as $f^k(\cdot)$ are defined by equations (8) and (9). Given the distributional assumptions on the error terms, $f^k(\cdot)$ is lognormal density, and $g(\cdot)$, $\phi^p(\cdot)$ and $\phi^g(\cdot)$ are normal densities. Since the integration in the likelihood function does not have an analytical solution, we use simulations and estimate the model using simulated maximum likelihood.[12]

The parameters to be estimated are as follows: (1) vectors β^p and β^g of coefficients of household and market level characteristics that enter the education spending equation and choice probabilities;[13] (2) parameters *h*, θ_1, θ_2, $q_1^{k,l}$, $q_2^{k,l}$, $q_3^{k,l}$, vectors α^p and α^g of coefficients of household and market level characteristics that enter only choice probabilities;[14] (3) parameters that enter the private school supply equation and the private school fee equation; (4) variance-covariance parameters of the various error terms.

3. Data Description

The dataset we use for estimation comes from two main sources. The first is the Survey of Living Conditions (SLC) conducted by World Bank between December 1997 and March 1998 in the neighboring states of Uttar Pradesh and Bihar in northern India. The survey spans 25 districts (12 in Uttar Pradesh and 13 in Bihar) and collects information

[11] For estimation, we weighted each observation in the likelihood by household weights available in the data.

[12] More specifically, we draw 500 draws from a Halton sequence for the integration. Halton sequences have been shown to provide better coverage than standard random number generators (Bhat, 2001).

[13] Note there are some parameters that are common across β^p and β^g.

[14] There are some parameters that are common across α^p and α^g.

from 2250 rural households living in 120 villages across these districts.[15] The survey has two components – household and village. In the household component, households were asked questions on family composition, family activities, education, health, expenditure, access to facilities, assets, farming and vulnerability to adverse conditions. The village component contains information on village characteristics, infrastructure, migration, employment, wages, organizations and agriculture. We use data on household school choices, household characteristics and village level infrastructure from these two components.

Our second source of data is Government of India's District Information System for Education (DISE). DISE is a database of all recognized schools in the states participating in the District Primary Education Program (DPEP). DISE contains school level information on school infrastructure, student enrollment, student characteristics, teacher characteristics, etc. Schools are categorized as Department of Education schools, Social Welfare Department schools, local body schools, private aided, private unaided and others. We coded private aided and private unaided schools are private schools and the rest as government schools.

The database also contains information on the year of establishment of the school. We used this information to calculate the total number of rural private and government schools that were operational in 1997-1998 at the block level.[16] Since the DISE database contains information only about recognized private schools, a large number of schools that are operating without government recognition are overlooked.[17] Statistics from the All India Education Survey (AIES) 2002 conducted by the Government of India indicate that there is a considerable number of unrecognized schools operating in the rural areas of Uttar Pradesh and Bihar. However, these numbers are available only at the state level and not at any lower level of aggregation. So we approximated the number of unrecognized schools at the block level by assuming that the number of such schools as a proportion of

[15] The survey does not cover the two states completely and the districts selected are among the poorer districts. Hence, the results of our model may not generalize to other areas of these states.

[16] A block is an administrative unit smaller than a district, but comprising of several villages

[17] A school cannot issue a transfer certificate or school leaving certificate if it does not have government recognition. This, however, does not deter many households from sending their children to unrecognized private schools, probably due to English language teaching and more accountable teachers. Government recognition comes at a cost too. A school has to meet infrastructure, teacher qualification and teacher pay requirements to get government recognition.

the number of government schools is the same as that at the state level. In other words, the number of unrecognized schools in each block is assumed to be a constant fraction of the number of government schools. These constant proportions for Uttar Pradesh are 13.8% for primary and 28.4% for upper schools. The same figures for Bihar are 6.4% for primary and 12.7% for upper schools.

The number of private schools at the primary level varies significantly across markets in our dataset (Figure 4). While a majority of markets have less than 10 private primary schools, a considerable number of markets have greater than 20 such schools. The situation is very different at the upper level, where most markets have less than 10 private schools and almost all have less than 20 such schools.

We used information on the geographic areas of blocks from Census of India 2001 to calculate the density of private and government schools in each block. This information was then matched with the household level information from the Survey of Living Conditions (SLC). Since the SLC does not contain block level identifiers, we first obtained information on the block that each village in SLC belonged to from National Habitation Survey 2003 conducted by the Department of Drinking Water Supply, Government of India. Using that information, we matched the data from DISE with data from SLC.

The matching described above was done at the block level instead of the village level for two reasons. First, the names of the villages in the two datasets were very different and hence very difficult to match. Second, more than 50% of the school going children in the SLC sample travel outside the village to go to school. This indicates that the schooling market for each household is not confined to the village of residence but is larger than that. Therefore, we used a block, which is the next level of geographic aggregation comprising of 50-100 villages, as a market. Block areas range from a minimum of 27.68 sq. km to a maximum of 944.87 sq. km (Table 1). However, the median area is 206.73 sq. km. Since a block area of 206.73 sq. km is not too large, it seems reasonable to treat a block as a market.

Using the relationship in equation (11), we calculated the distance to closest school from density of schools in a market. Our data indicate that, on average, distance to closest government primary and upper schools is lower than the distance to closest private schools at the same level (Table 1). In fact, the closest private primary school is, on average, thrice as far as the closest government primary school, which means that children travel much larger distances to go to private primary schools than government primary schools. Furthermore, they seem to travel even larger distances to go to a private upper school.

To create the final dataset, we selected households that had at least one member of school going age, i.e. between the ages 6 and 17. We also dropped a small number of observations where the child was attending a religious non-formal school. This left us with 3056 observations on 1307 households from 102 villages, which were used for estimation. Private school enrollment numbers and educational spending figures for our final dataset are provided in Figure 3. Interestingly, the number of students enrolled in private schools in Uttar Pradesh is greater in the higher grades (upper) than in primary schools. Further, as mentioned before, the phenomenon of private school enrollment is not confined to high income households. In Figure 3 we provide private school enrollment numbers for the top, middle and bottom thirds of the MPCE (monthly per capita income) distribution for both states. While a greater proportion of high income households send their children to private schools, the numbers are significant for low income households as well.

4. Empirical Results and Implications for Private Schooling

4.1. Model Results

We estimate two models – one without and the other with endogneity correction for private school supply and fees. The empirical results for the two models are presented in Tables 2 and 3 respectively. The correlation between private school demand and unobserved fee shocks is not significant, suggesting that that endogeneity is not a serious concern in these markets.[18] Hence the estimates in the two tables are not qualitatively different.

---

[18] We also use average private school fee in the district (a district consists of several block-level markets) excluding the block under consideration as an instrument for private school fee and the results were similar.

The interaction of wage and child's age is positive.[19] Since we used these variables to control for child's income if the child is sent to work, the result indicates increasing opportunity cost of schooling with age. This is interesting when compared with the effect on age on marginal utility from education spending which is convex, meaning that households get increasingly greater utility from spending on education of older children. Seen together, these results imply that the opportunity cost of a child's time increases with age causing households to be reluctant to send older children to school. However, conditional on schooling, they also spend more on older children's education, probably because they are closer to finishing school or their level of schooling requires greater expenditure. Therefore, the net effect of age on school enrollment, as our simulations indicate, is not straightforward due to these two opposing forces. We present those results in the next section.

We also find caste based differences in schooling in that SC/ST (Scheduled Caste/ Scheduled Tribe) households are less likely to send their children to government schools and even less likely to send children to private schools.[20] Households deriving most of their income through agriculture are also less likely to send children to school. However, the opposite is true of land owners. Overall households in Uttar Pradesh (UP) place a higher value on schooling than Bihar and that the effect is more pronounced for private schooling. While the same would be expected of spending on education, the effect is surprisingly reversed, with households in Bihar spending more on education conditional on sending children to school. These results highlight the significant differences across states in India, even neighbors like Uttar Pradesh and Bihar. Ignoring such differences among states can lead to incorrect conclusions and business decisions.

Although we do not have actual household incomes, we used monthly per capita expenditure (MPCE) of households as a proxy. The effect of income, however, may be confounded with ability as households with higher income could have higher ability which would affect their inclination towards education. We, therefore, partially control for unobserved ability through parents' education and find that both utility from

[19] Daily wage is the average daily wage across various activities (agricultural, labor, etc) for men in the village.

[20] SC/ST are population groupings that have historically been backward and oppressed, and are defined in official schedules developed by the Government of India and used for affirmative action programs.

schooling and education spending are increasing in MPCE, implying that higher income households get higher utility from sending children to school and they also spend more on their children's education. The effect of parents' education is also significant, with primary (or above) educated parents spending significantly more on education and the effect is higher if the mother has completed primary education. Keeping MPCE constant, the effect of household size is negative on education spending, implying that households with bigger families are less likely to spend less on educating children, possibly due to limited resources.

Turning to other shifters of marginal utility of education spending, the presence of educational programs run by non-governmental agencies in the market (Other Educational Program) has a positive and significant effect, suggesting the presence of complementarity between schooling and out-of-school educational programs. We also find that greater temporary migration for skilled jobs outside the village is associated with higher marginal utility from educational spending. We created a measure called Migration Proportion, which is the number of villagers that leave the village temporarily for skilled jobs as a proportion of the total number of households in the village, to capture this effect.[21] However, the effect that we find may be due to two reasons. First, greater number of village people migrating for skilled jobs creates awareness about education in the village and that leads to greater emphasis on education. Second, villages that traditionally have had greater emphasis on education have greater migration for skilled jobs and also have greater school enrollments. Unfortunately, with just cross-section data on migration we cannot disentangle these two explanations and establish causality.

Distance to the school appears to be a significant impediment to village children's education in India. As distance to the closest school increases, the cost of travel increases. However, the effect is nonlinear in nature with the marginal cost of travel declining with distance. In other words, increasing the distance to closest school from 0.5 km to 1 km has a bigger impact on lowering school enrollment than increasing it from 1.5 km to 2 km. Not surprisingly, the effect of distance is lower for children above the age of 10. This implies that the cost of travel for younger children is higher as they either get tired more

[21] Skilled labor, tailoring, factory work, salaried employment, petty business, bus conducting, etc were coded as skilled jobs and agricultural labor, masonry, foraging, milk selling, road construction, construction, rickshaw pulling, brick making, etc were coded as unskilled labor.

easily or need someone to accompany them to school. The effect of distance is also found to be lower for households with vehicles (bicycle, motorcycle or car), which means that the disutility to households from travel can be alleviated by providing them with transportation options. These results together imply that availability and accessibility constraints are significant barriers to schooling in rural India. The impact of these constraints in the developed world may not be significant, if not non-existent, as school availability or distance is rarely cited as a reason for children dropping out of school (see for e.g., Eckstein and Wolpin, 1999). However, in the case of a developing country, this is the reality faced by millions of households and cannot be overlooked.

Consistent with previous research (e.g., Dreze and Kingdon, 2001), we find a bias against educating the girl child. The base utility for girls from both private and government schooling is lower than boys. Households also get lower marginal utility from spending on girls' education and even less so for private education. This bias could be due to various reasons viz., labor market discrimination against women, lower returns to education for women, etc (see Kingdon, 1998). Not only are the benefits to their education perceived to be lower, girls seem to be doubly marginalized as the costs are viewed to be higher. Distance appears to be a greater impediment to education for girls relative to boys. In other words, if the distance to closest school increases, girls' education is more adversely affected than boys' education. This is consistent with Burde and Linden (2009) who also find that girls are more sensitive to distance than boys with respect to school enrollment in Afghanistan. This result has important policy implications. Policies aiming to increase female enrollment in rural schools need to adopt a two pronged strategy. They should not only emphasize the benefits of educating the girl, but also take measures to reduce their psychic and real cost of travel.

4.2 Discussion and Policy Simulation

4.2.1 Effect of Age and Distance

We first simulate the effect of child's age on private school enrollment. The impact of age is not straightforward as age affects enrollment in two ways. It increases the opportunity cost of sending the child to school, thereby reducing enrollment probability. But it also increases the marginal utility from education spending, thereby increasing enrollment probability. In order to isolate the total effect of age, we look at private school enrollments at various ages, keeping all the other variables fixed at their mean values. The results are presented in Figure 5.

We find that private school enrollment in Uttar Pradesh increases with age for boys, with enrollments highest for the 14-16 age group. The situation is a little different for girls, with private school enrollment lowest for the 8-10 age group but increasing after that. Overall, private school enrollment levels are lower for girls as compared to boys. The pattern is repeated in the case of Bihar, with the major difference that private school enrollment levels are lower than Uttar Pradesh. These simulations show that, given the values we have chosen for the other variables, the value of private schooling is highest for 14-16 year olds among both boys and girls, making them the most attractive target segments from the private schools' perspective. Our model, therefore, has implications for age based segmentation and targeting in the private schooling industry.

Conditional on schooling (either government or private), the average amount spent per child on education also increases with age. The amount spent on girls, however, rises slowly than the amount spent on boys. Overall, the amount spent on the 14-16 year old group is almost three times as large as that spent on the 6-7 year old group. This has implications for the ancillary industries like books, stationery and uniform suppliers as areas with greater proportion of 14-16 year olds are likely to have greater expenditures on these items.

In order to understand how private school enrollments change as distance to closest private school changes, we first look at the enrollments at the distances observed in our dataset. The range of distances observed in the data for private primary schools is 1.08 km to 4.08 km, and for private upper schools is 1.78 km to 13.08 km. We look at the enrollments by increasing and decreasing the distance to closest private primary school and upper school by 0.5 km in the case of Uttar Pradesh. We find that by increasing the distance to closest primary school by 0.5 km, private school enrollment for boys in Uttar Pradesh drops from 28.4% to 24% and for girls in the same state drops from 22.5% to 18.1% (Figure 6). Therefore, the effect of distance has a significant effect on both girls and boys in terms of reducing their private school enrollment. In the case of private upper schools, we find a similar pattern although the decline in enrollment is lower (relative to private primary schools), falling from 32.9% to 30.8% for boys and from 23.4% to 21% for girls. Similar computation of distance elasticities with respect to enrolment and spending is valuable for private schools deciding on where to locate new schools.

4.2.2 Relative Impact of Fees and Travel Cost

Our results above show that distance is an impediment to children's enrolment in school. Also we find that households with vehicles have lower travel cost to school. How would households tradeoff this transportation cost against potentially higher fees? How would changes in the marketing mix through higher fees and easier transportation affect enrolment?

As Gurcharan Das of SKS Microfinance that opened low-cost private schools in rural India says, "*We didn't think that poor parents would want to pay the cost of bussing their children to school, which would double the fees, but they are. We don't want to be in the bus transport business, but parents are insisting on it. So from next year we are going to trial bus transport in half our schools.*"[22]

To evaluate whether rural households would be willing to pay higher fees to reduce their travel cost, we simulate the following marketing intervention in an "average market" (a market with households having mean demographic characteristics) in Uttar Pradesh. We allow all households to have a vehicle, to simulate availability of transportation and lower travel cost, but double the private school fee from Rs. 25/month to Rs. 50/month, to simulate the increased cost schooling due to transportation charges.

We find that doubling the fee lowers private school enrollment by 14.13% and most of it (10.53%) is lost to government schools (Table 4). Provision of vehicle, on the other hand, increases private school enrollment by 15.81%. A majority of this increase is due to market expansion (12.66%) rather than business stealing from government schools (3.15%). This implies that provision of transportation options is likely to have beneficial effects on total enrollment in schools. When both marketing interventions (increase in fee and vehicle in the household) are applied, the net effect on private school enrollment is negligible (0.64%). This indicates that households are willing to trade-off the increased cost of schooling for a reduced travel cost. For girls, the positive effect of reduced travel

[22] Gurcharan Das, "India's private sector steps in," The Guardian Weekly, December 11, 2008.

cost appears to more than compensate for the negative effect of increased fees, highlighting gender differences in the impact of travel cost.

4.2.3 Operating Cost and Optimal Number of Private Schools

Private school enrollment depends on various market characteristics, including distance to closest private school, which in turn depends on the density/number of private schools. As our model gives the demand response to private school supply, it can be used to calculate the optimal number of private schools in a market given the costs. This is particularly useful from a policy perspective if the government wants to institute public-private partnership to attract more private schools in a market to combat non-enrollment. Moreover, if private schools are found to be performing better than government schools in terms of educational outcomes, public funds might be more efficiently utilized by opening more private schools than government schools. One way to increase the number of private schools is to provide them with subsidies that reduce their operating costs and make entry easier (Kingdon, 2007). Our model can be used to determine the reduction in operating cost required to induce more private school entry in the market.

To calculate the optimal number of private schools in a market, let the profits of a private school be given by

$$\pi = \frac{F \times \Pr \times Pop}{N} - C$$

where F is the monthly fee charged by the school, Pr is the proportion of children going to private school, Pop is the population of children in the market, N is the number of private schools in the market and C is the monthly operating cost. The profits can be rewritten as

$$\pi = \frac{F \times \Pr \times Popden}{\lambda} - C$$

where $Popden$ is the population density of children in the market and λ is the density of private schools in the market.

Note that, as we had shown earlier, distance to closest school is inversely related to the density of schools in a market. Since Pr depends on the distance to closest school, it also depends on λ, the density of private schools in the market. Assuming homogeneity of private schools, entry of private schools will occur in the market until the net profits of all schools are equal to zero. Therefore, the optimal density of private schools, λ^*, in the market is such that

$$\frac{F \times \Pr\left(\lambda^*\right) \times Popden}{\lambda^*} = C \qquad \text{….. (12)}$$

This equation is nonlinear in λ^* and can be solved using any standard nonlinear equation solver or using a grid search over different values of λ^*, which can be used to calculate *N**, the optimal number of private schools in the market. In Figure 7, we present optimal number of private primary and upper schools in two markets in the state of Uttar Pradesh, for different values of operating cost.

First consider a market with population density of 540.51/ sq. km (this is close to the median population density of children in the 6-17 age group) and area of 264.1 sq. km. By reducing the monthly cost of operation of each private primary school from Rs. 11,500 to Rs. 8,500, the number of private primary schools in the market can be increased by 50%, from 25 to 37. Concomitantly the proportion of children in the same age group that are out of school decreases from 15.2% to 14.2%. Therefore, by providing a subsidy of Rs. 3,000 per month to private primary schools, the proportion of children that are out of primary schools can be reduced by 6.5%, which roughly translates to 1308 more children in school.

Similarly, the number of private secondary schools in this market increases from 5 to 10, leading to a reduction in the proportion of out of school children from 32.2% to 27.8%, as monthly operating cost is reduced from Rs. 72,000 to Rs. 44,000 per month. Therefore, a subsidy of Rs. 28,000/month for each private school reduces the number of out of school children by 13.7% and leads to 3663 more children in school.

4.2.4 Effect of Travel Cost on Optimal Supply of Private Schools

While the demand for schooling is likely to increase with marketing interventions that reduce household travel cost (e.g., introduction of transportation options), the overall effect on the supply of private schools in the market is not clear. Does it increase or decrease?

For simplicity, let t be the unit travel cost parameter. In equation (12), Pr (probability of enrolment) depends on the unit travel cost parameter, as it determines households' sensitivity to distance. Therefore, Pr is a function of both t and λ (private school density).

$$\Pr\left(t,\lambda^{*}\right)=\frac{\lambda^{*}\times C}{F\times Popden}$$

Differentiating both sides with respect to t, we get

$$\frac{\partial \Pr}{\partial t}+\frac{\partial \Pr}{\partial \lambda^{*}}\frac{d\lambda^{*}}{dt}=\frac{d\lambda^{*}}{dt}\left(\frac{C}{F\times Popden}\right)$$

$$\Rightarrow \frac{\dfrac{\partial \Pr}{\partial t}}{\left(\dfrac{C}{F\times Popden}-\dfrac{\partial \Pr}{\partial \lambda^{*}}\right)}=\frac{d\lambda^{*}}{dt}$$

Now, $\frac{\partial \Pr}{\partial t}<0$, $\frac{\partial \Pr}{\partial \lambda^{*}}>0$ and $\frac{C}{F\times Popden}>0$.

Therefore,

$$\frac{d\lambda^{*}}{dt}>0 \text{ if } \frac{\partial \Pr}{\partial \lambda^{*}}>\frac{C}{F\times Popden} \quad \text{and} \quad \frac{d\lambda^{*}}{dt}<0 \text{ if } \frac{\partial \Pr}{\partial \lambda^{*}}<\frac{C}{F\times Popden}$$

In other words, if the sensitivity of enrollment to school density $\frac{\partial \Pr}{\partial \lambda^{*}}$ is large, at the given monthly operating cost *C*, a decrease in unit travel cost reduces the optimal density of private schools.[23] Why? The intuition is as follows. A decrease in unit travel cost has two effects – enrollment effect, due to increase in private school enrollment and competition effect, due to willingness of children to travel larger distances inducing more competition between schools. But while the enrollment effect increases density of private schools, the competition effects decreases it. When $\frac{\partial \Pr}{\partial \lambda^{*}}$ is large, the number of private schools in the market is large (as there are greater returns to entry) and hence distances to schools become smaller. Therefore, a reduction in unit travel cost does not increase

[23] Note that $\frac{\partial \Pr}{\partial \lambda^{*}}$ itself depends on the operating cost *C*, as the optimal density λ^{*} depends on *C*.

private school enrollment by much and the competition effect dominates, leading to lower private school density in the market.

On the other hand, for smaller values of $\frac{\partial \Pr}{\partial \lambda^*}$ at the given operating cost *C*, a decrease in unit travel cost increases the optimal density of private schools. For small $\frac{\partial \Pr}{\partial \lambda^*}$, there are fewer private schools in the market and hence distances to private schools are high. Therefore, a reduction in unit travel cost has a bigger effect on private school enrollment and this effect dominates the competition effect, thereby increasing the private school density in the market. While the effect of decrease in unit travel cost is opposite for small and large $\frac{\partial \Pr}{\partial \lambda^*}$, the effect on total enrollment in schools (both government and private) is always positive, as reduction in unit travel cost decreases the disutility from travel to school.

We find that, at the estimated parameters, the latter case is obtained for all values of operating cost *C*. Therefore, our results imply that a reduction in unit travel cost would lead to an increase in the optimal density of private schools.

5. Conclusion

Fueled by the failure of the government schooling system to provide quality education, private schools have gained substantial share across a broad cross-section of the Indian socio-economic strata. Demographic patterns suggest that the share of children is likely to increase in the foreseeable future; hence the demand for schooling will rise. Demand for private schooling is expected to rise even further as the economy expands and incomes rise across the population.

We present a discrete-continuous model of household school choice and educational spending decisions, and estimate it using household level data from rural India. Our analysis gives insight on how households tradeoff the value of government and private schooling for kids, relative to working and how this value varies with household specific and market factors. We find strong gender effects in that the value of private schooling for the girl child is significantly lower. We also find that enrollment probability in private schools rises as the child grows older. Distance to school is found to be a major impediment to schooling for rural Indian households and we find differential distance effects based on gender, age and vehicle ownership. Girls, younger children and households without a bicycle, motorcycle or car are found to face higher travel costs.

By comparing the relative impact of fees and transportation--two elements of the marketing mix on enrolment, we find that provision of transportation increases enrolment roughly equivalent to the same levels as doubling of fees reduces enrolment. We also assess how subsidies for the private sector will affect the entry of private schools and its resulting impact on reducing the number of children out of school. Our analysis contributes to the debate on value of private-public sector partnerships in the education sector in India in increasing enrolment in schools.

Our study, like any other, has limitations. We ignore differences in quality among private schools and assume them to be homogeneous. However, the markets that we consider are large, comprising of a large number of schools and hence a quality based analysis is not feasible. A fruitful area for further research, although which requires more detailed disaggregate data, is to consider a smaller market with fewer schools to model quality competition between private and government schools. The definition of quality itself in the schooling market deserves further examination. We also do not fully consider the effect of income on school choice, as we do not have actual income data. We have used total consumption expenditures of the household as a proxy for income in our current analysis. However, income is likely to be an important determinant of schooling (Glewwe and Jacoby, 2004), especially for poor households with limited discretionary incomes and therefore deserves further attention. Further, it would be important to look at household schooling choices in a dynamic setting. In this paper, we could not undertake such analysis due to availability of only cross-sectional data.

We have taken a first step in the quantitative marketing literature towards understanding the determinants of demand for education in an emerging economy. We illustrate the relevance of such analysis for both private school entrepreneurs in entry decisions and setting the market mix. Given the critical importance of school education for the long run economic growth and sustained development (Barro, 2002; Poddar and Yi, 2007), the research is also of great importance to public policy. We hope our research will spur further analysis of education consumption in emerging markets.

References

Barro, Robert (2002), "Education as a Determinant of Economic Growth," in E.P. Lazear, ed., *Education in the Twenty-First Century*, Hoover Institution Press.

Bayer, Patrick and Robert McMillan (2005), "Choice and Competition in Local Education Markets," *Working Paper*.

Belzil, Christian (2007), "The Return to Schooling in Structural Dynamic Models: a Survey," *European Economic Review*, 51, 1059-1105.

Bhat, Chandra R. (2001), "Quasi-Random Maximum Simulated Likelihood Estimation of the Mixed Multinomial Logit Model," *Transportation Research Part B*, 35, 677-693.

Burde, Dana and Leigh L. Linden (2009), "The Effect of Proximity on School Enrollment: Evidence from a RCT in Afghanistan," *Working Paper*, Columbia University.

Card, David (2001), "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems," *Econometrica*, 69(5), 1127-1160.

Chaudhary, Nazmul, Luc Christiaensen and Mohammad Niaz Asadullah (2006), "Schools, Household, Risk and Gender: Determinants of Child Schooling in Ethiopia," *Working Paper*, Centre for the Study of African Economies, Oxford University.

CLSA (2008), "Indian Education: Sector Outlook," Credit Lyonnais Securities Asia.

Cottam, Grant and J.T. Curtis (1956), "The Use of Distance Measures in Phytosociological Sampling," *Ecology*, 37, 741-757.

Drèze Jean and Geeta G. Kingdon (2001), "School Participation in Rural India," *Review of Development Economics*, 5(1), 1-24.

Eckstein, Zvi and Kenneth Wolpin (1999), "Why Youths Drop Out of High School: The Impact of Preferences, Opportunities and Abilities," *Econometrica*, 67(6), 1295-1339.

Edmonds, Eric, Nina Pavcnik and Petia Topalova (2007), "Trade Adjustment and Human Capital Investments: Evidence from Indian Tariff Reform," *Working Paper*, Dartmouth College.

Epple, Dennis and Richard Romano (1998), “Competition Between Public and Private Schools, Vouchers, and Peer Group Effects,” *American Economic Review*, 88(1), 33-62.

Foster, Andrew and Mark Rosenzweig (1996), “Technical Change and Human-Capital Returns and Investments: Evidence from the Green Revolution,” *American Economic Review*, 86(4), 931-953.

Glewwe, Paul and Hanan Jacoby (2004), “Economic Growth and the Demand for Education: Is There a Wealth Effect?,” *Journal of Development Economics*, 74, 33-51.

Hanemann, W. Michael (1984), “Discrete-Continuous Models of Consumer Demand,” *Econometrica*, 52(3), 541-561.

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

Kingdon, Geeta G. (2007), “Public Private Partnerships in Education: Some Policy Questions,” *Policy Brief*, Research Consortium on Educational Outcomes & Poverty, 1, 1-4.

Kremer, Michael, Karthik Muralidharan, Nazmul Chaudhury, Jeffrey Hammer and F. Halsey Rogers (2005), “Teacher Absence in India: A Snapshot,” *Journal of the European Economic Association*, 3(2-3), 658-667.

Kruger, Diana, Rodrigo R. Soares and Matias Berthelon (2007), “Household Choices of Child Labor and Schooling: A Simple Model with Application to Brazil,” *Working Paper*, IZA Discussion Papers 2776, Institute for the Study of Labor (IZA).

McKinsey Global Institute (2007), “The Bird of Gold: The Rise of India’s Consumer Market,” *Research Report*, McKinsey & Co.

Muralidharan, Karthik and Michael Kremer (2007), “Public and Private Schools in Rural India,” *Working Paper*, Harvard University.

Poddar, Tushar and Eva Yi (2007), “India’s Rising Growth Potential,” *Global Economics Paper No: 152*, Goldman Sachs Economic Research.

Pratham (2008), “Annual Status of Education Report – 2007,” Pratham Resource Center.

Villas-Boas, M. J. and R. S. Winer (1999), “Endogeneity in brand choice models,’ *Management Science*, 45(Oct), 1324-1338.

Table 1. Summary statistics for markets

	Mean	Median
Private Primary Distance (km)	2.3	2.07
Private Upper Distance (km)	4.01	3.63
Government Primary Distance (km)	0.8	0.78
Government Upper Distance (km)	2.07	1.92
Private School Fee (Rs./month)	25.29	20.17
Population Density (Age 6-17 per sq. km)	845.01	535.37
Geographic Area (sq. km)	276.95	206.73

Table 2. Demand Model

	Parameter Estimate	t-statistic
Variables entering indirect utility		
Private School Fee	**1.474**	5.488
Wage	**-14.676**	-2.157
Wage * Age	**27.047**	4.296
Distance	**12.639**	12.168
Distance^2	**-3.621**	-3.814
Distance*(Age > 10)	**-3.655**	-5.959
Distance*Vehicle	**-3.317**	-8.433
Distance*Girl	**1.852**	3.850
Indicator Girl	**-1.042**	-11.056
Intercept - Private	**-0.862**	-2.372
Indicator Land - Private	**0.445**	3.059
Indicator SC/ST - Private	**-1.002**	-6.750
Indicator Agriculture - Private	**-0.606**	-5.097
MPCE - Private	**3.879**	12.492
Indicator UP - Private	**2.213**	11.605
Intercept - Govt	0.098	0.425
Indicator Land - Govt	**0.588**	7.954
Indicator SC/ST - Govt	**-0.305**	-4.087
Indicator Agriculture - Govt	**-0.200**	-2.500
MPCE - Govt	**3.204**	13.051
Indicator UP - Govt	**0.914**	9.294
Variables entering education spending		
Constant - Private School	**-1.284**	-4.228
Indicator Girl - Private	**-0.171**	-4.362
Constant - Govt School	**-1.596**	-5.275
Indicator Girl - Govt	**-0.112**	-4.479
Age	**0.900**	3.394
Age^2	0.224	1.832
Household Size	**-0.058**	-2.290
Primary Education - Father	**0.244**	11.114
Primary Education - Mother	**0.416**	14.934
MPCE	**0.603**	14.792
Indicator - Land	**0.064**	2.275
Other Educational Program	0.116	1.906
Migration Proprotion	**0.674**	9.560
Indicator UP	**-0.158**	-7.023
σ_p	**2.598**	17.773
σ_g	**0.714**	15.304
ρ_{pg}	**0.712**	15.830
$\sigma_{\upsilon p}$	**0.746**	56.185
$\sigma_{\upsilon g}$	**0.826**	96.519

Note: (1) UP is Uttar Pradesh
(2) MPCE is Monthly Per Capita Expenditure
(3) "- Private" indicates parameters corresponding to private schools; same for government schools.

Table 3a. Demand Model with Endogeneity Correction

	Parameter Estimate	t-statistic
Variables entering indirect utility		
Private School Fee	**1.562**	5.281
Wage	**-14.981**	-2.426
Wage * Age	**25.692**	4.102
Distance	**11.465**	11.462
Distance^2	**-3.232**	-3.440
Distance*(Age > 10)	**-3.414**	-5.733
Distance*Vehicle	**-2.421**	-6.520
Distance*Girl	**1.551**	3.414
Indicator Girl	**-1.000**	-11.208
Intercept - Private	**-1.012**	-3.071
Indicator Land - Private	**0.603**	4.467
Indicator SC/ST - Private	**-1.106**	-7.688
Indicator Agriculture - Private	**-0.761**	-6.971
MPCE - Private	**4.250**	13.916
Indicator UP - Private	**2.051**	11.358
Intercept - Govt	-0.189	-0.929
Indicator Land - Govt	**0.638**	8.897
Indicator SC/ST - Govt	**-0.325**	-4.432
Indicator Agriculture - Govt	**-0.152**	-2.099
MPCE - Govt	**3.440**	14.273
Indicator UP - Govt	**0.914**	9.687
Variables entering education spending		
Constant - Private School	**-1.227**	-3.744
Indicator Girl - Private	**-0.169**	-4.307
Constant - Govt School	**-1.535**	-4.698
Indicator Girl - Govt	**-0.114**	-4.543
Age	**0.961**	3.629
Age^2	0.194	1.594
Household Size	**-0.058**	-2.286
Primary Education - Father	**0.245**	11.178
Primary Education - Mother	**0.420**	15.057
MPCE	**0.601**	14.727
Indicator - Land	**0.062**	2.196
Other Educational Program	0.118	1.941
Migration Proprotion	**0.674**	9.568
Indicator UP	**-0.157**	-6.965
σ_p	**2.551**	17.088
σ_g	**0.657**	15.127
ρ_{pg}	**0.695**	14.573
$\sigma_{\upsilon p}$	**0.745**	56.311
$\sigma_{\upsilon g}$	**0.827**	96.355

Note: (1) UP is Uttar Pradesh
(2) MPCE is Monthly Per Capita Expenditure
(3) "- Private" indicates parameters corresponding to private schools; same for government schools.

Table 3b. Demand Model with Endogeneity Correction (contd.)

	Parameter Estimate	t-statistic
Variables entering private primary density		
Constant	**-4.013**	-49.729
Population Density	**0.318**	6.084
Density - Govt School	**0.874**	10.928
Indicator UP	**0.517**	5.484
σ_{η}^{prim}	**0.334**	12.740
$\rho_{\eta p}^{prim}$	-0.111	-0.842
Variables entering private upper density		
Constant	**-5.137**	-45.040
Population Density	**0.215**	3.195
Density - Govt School	**5.927**	8.648
Indicator UP	**0.856**	6.656
σ_{η}^{upper}	**0.433**	12.765
$\rho_{\eta p}^{upper}$	-0.119	-0.890
Variables entering private fees		
Constant	**-1.556**	-17.346
Log-Cost of Agricultural Land (per acre)	**0.220**	1.998
σ_{η}^{F}	**0.739**	12.814
$\rho_{\eta p}^{F}$	-0.010	-0.075

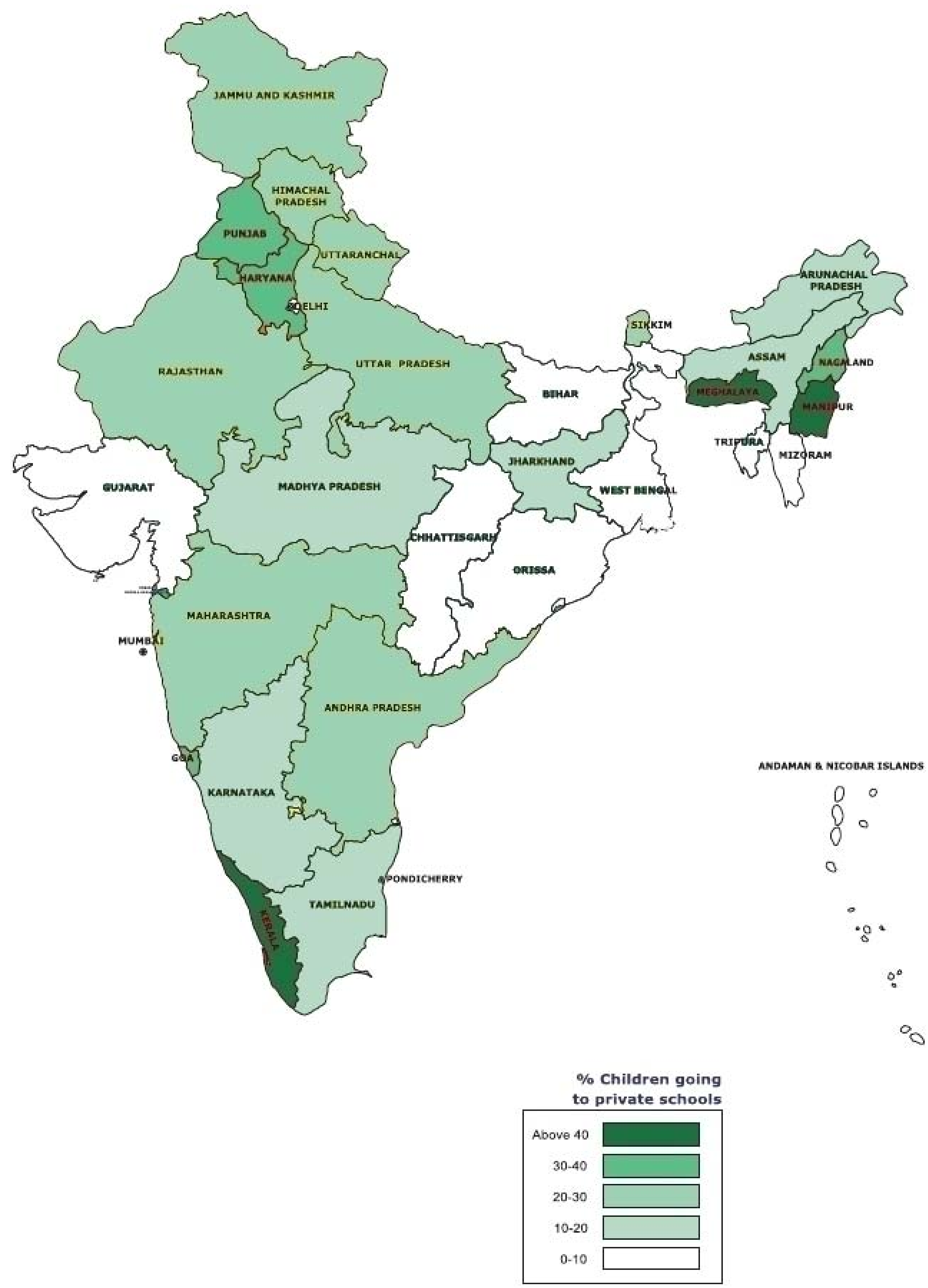
Note: (1) UP is Uttar Pradesh
(2) MPCE is Monthly Per Capita Expenditure
(3) “- Private” indicates parameters corresponding to private schools; same for government schools.

Table 4. Relative Impact of Fees and Travel Cost

Marketing Intervention		Change in pvt enrollment	Business stealing from govt schools	Change in total enrollment
(i) Double fees from Rs. 25 to Rs. 50		-14.13%	-10.53%	-3.60%
(ii) Have a vehicle in the household		15.81%	3.15%	12.66%
Both (i) & (ii)	Total	0.64%	-8.66%	9.30%
	Boys	-0.08%	-5.78%	5.70%
	Girls	1.53%	-12.20%	13.75%

Note: All percentages are calculated relative to the change in private school enrollment.

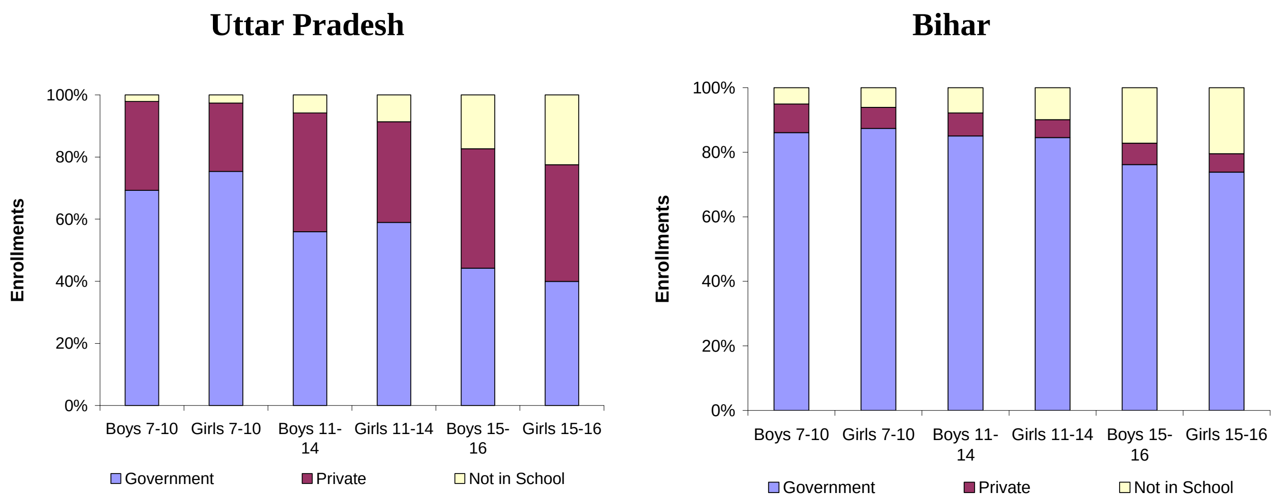
Figure 1. Map showing rural private school enrollments across states for the age group of 6-14 years



Maps may not be accurate or to scale. These are mere representations.

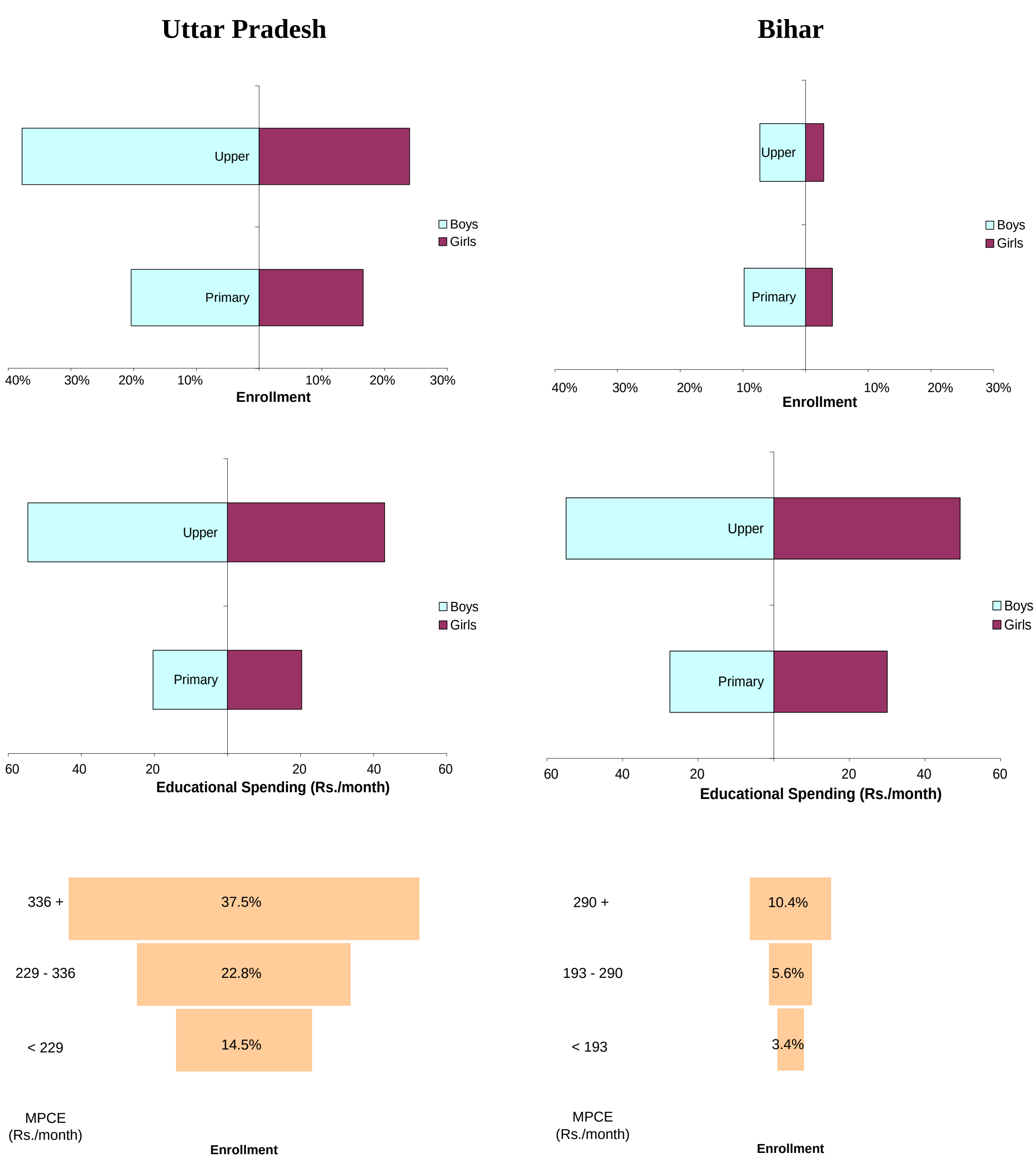
Source: Annual Status of Education Report (ASER) 2007

Figure 2. School enrollments in rural Uttar Pradesh and Bihar



Data Source: Annual Status of Education Report (2007)

Figure 3. Private school enrollment and educational spending (SLC data)



Note: MPCE is monthly per capita expenditure

Figure 4. Histogram of rural private schools across markets

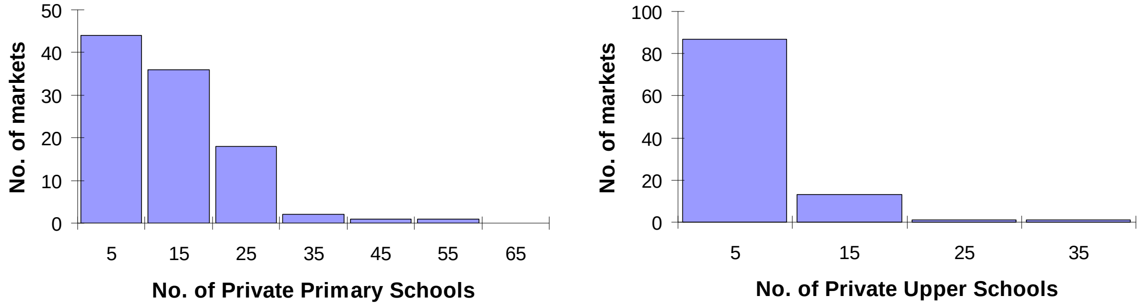


Figure 5. Effect of age on private school enrollment probability and average education spending

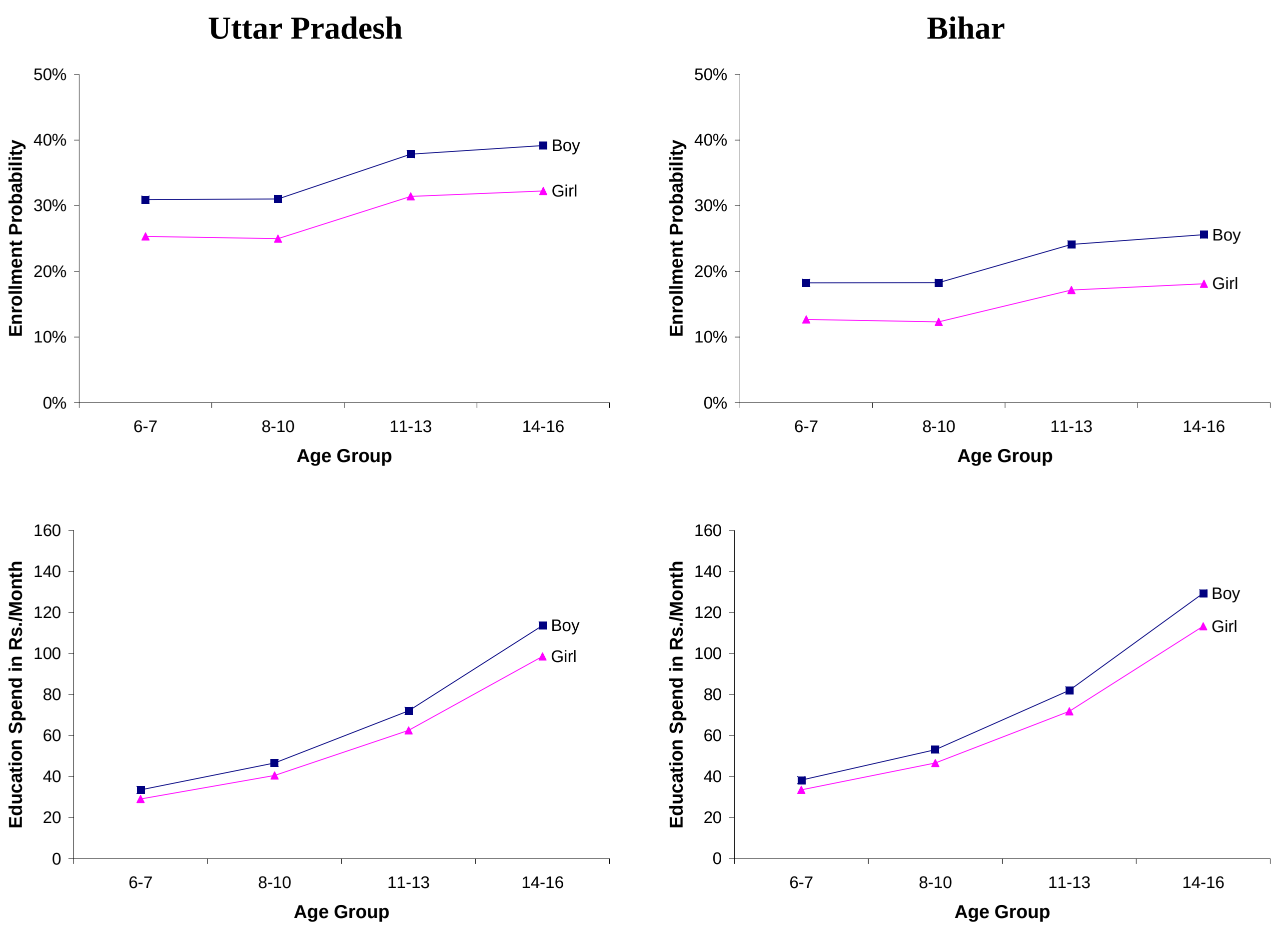


Figure 6. Effect of distance on private school enrollment and average education spending (conditional on schooling) in Uttar Pradesh

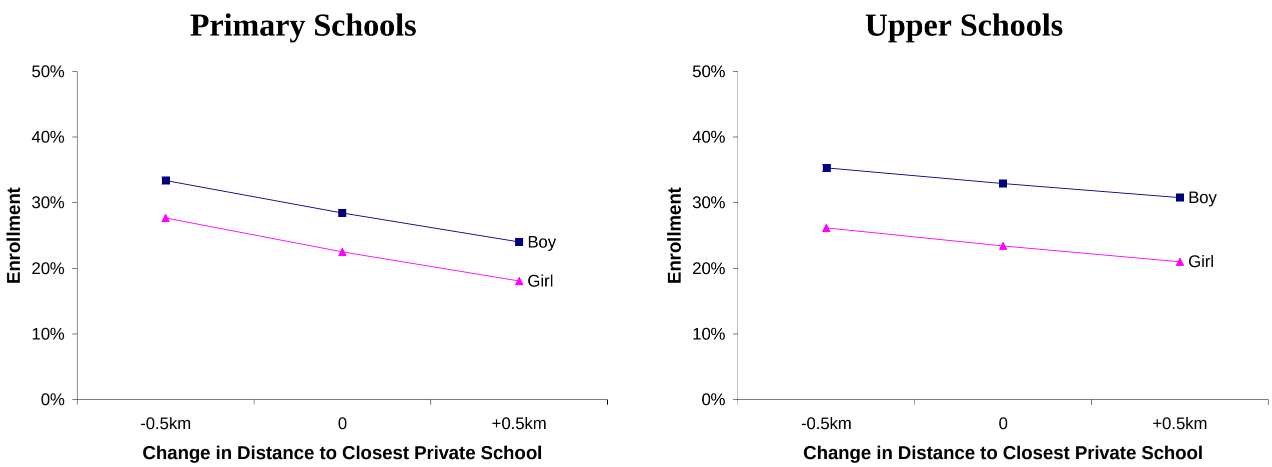


Figure 7. Effect of operating cost on optimal number of private schools